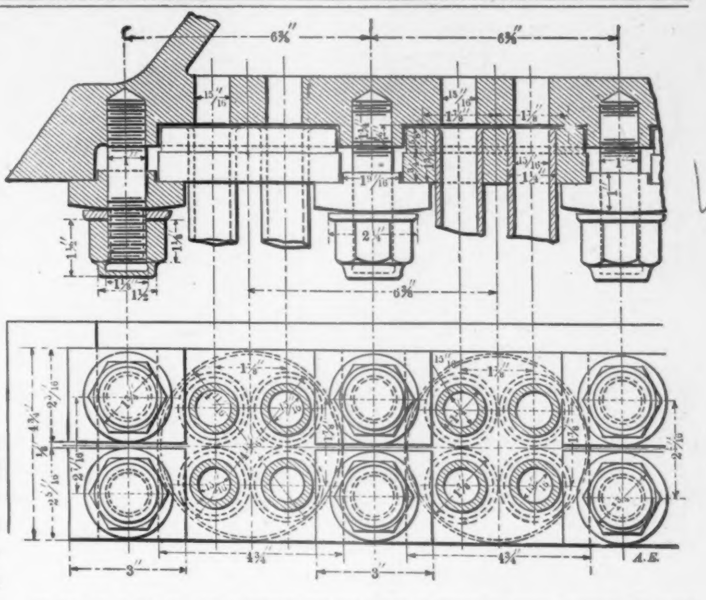
(Established 1832.)
AMERICAN ENGINEER AND RAILROAD JOURNAL.

SEPTEMBER, 1903.



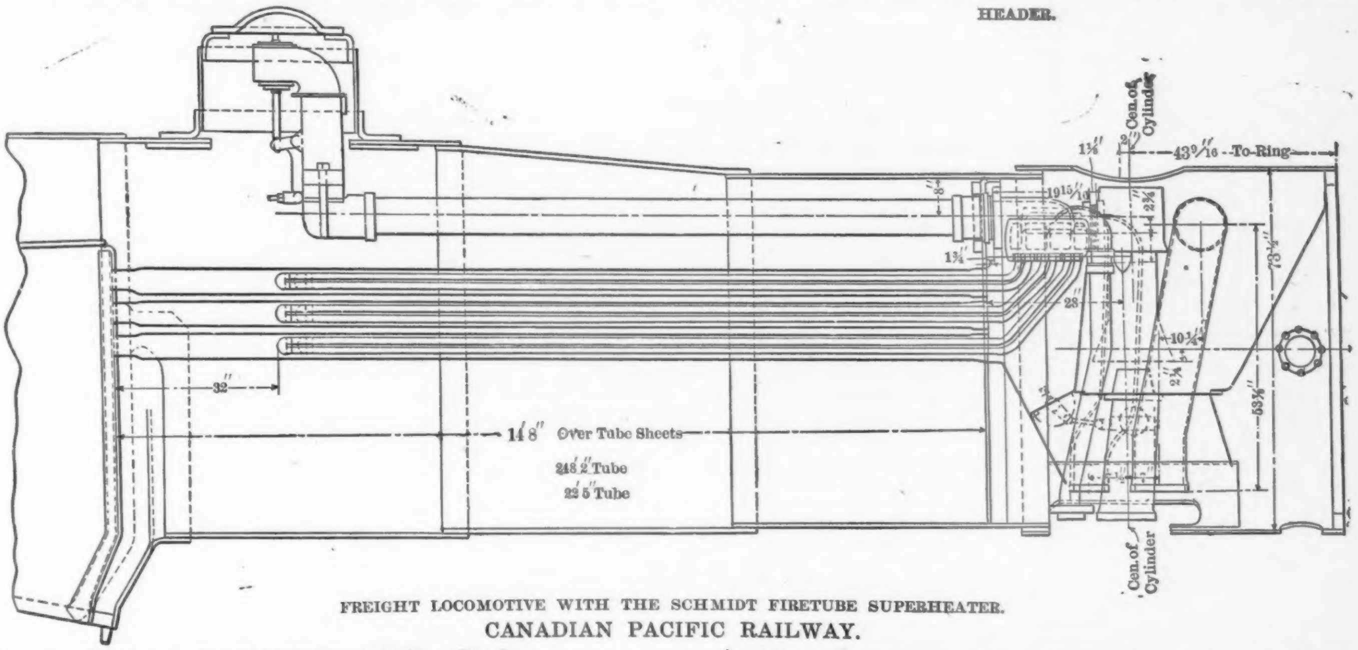
DETAILS OF THE ATTACHMENT OF THE SUPERHEATER TUBES TO THE HEADER.

COMPOUND LOCOMOTIVE WITH SUPERHEATER.

4—6—0 TYPE, FREIGHT.

CANADIAN PACIFIC RAILWAY.

In June, 1901, the Canadian Pacific Railway equipped a locomotive of the 4—6—0 type with the Schmidt system of superheating. It gave very gratifying results in fuel consumption and in operation. The locomotive was tested in comparison with a simple and a compound of similar construction and weight, the test continuing for eighteen months. On the ton-mile basis the superheater engine made an average saving in fuel of 31.3 per cent. over the simple engine and 10.6 per cent. over the compound, the cost of repairs being about the same for all three engines. These results led to the application of a Schmidt superheater to one of a lot of heavy 4—6—0 freight compounds, which are building at the Schenectady Works of the American Locomotive Company. Mr. E. A. Williams, superintendent of rolling stock of the Canadian Pacific, by whose permission this description is presented, believes that improvements in superheaters which will reduce the cost will render these devices highly desirable for locomotive service.

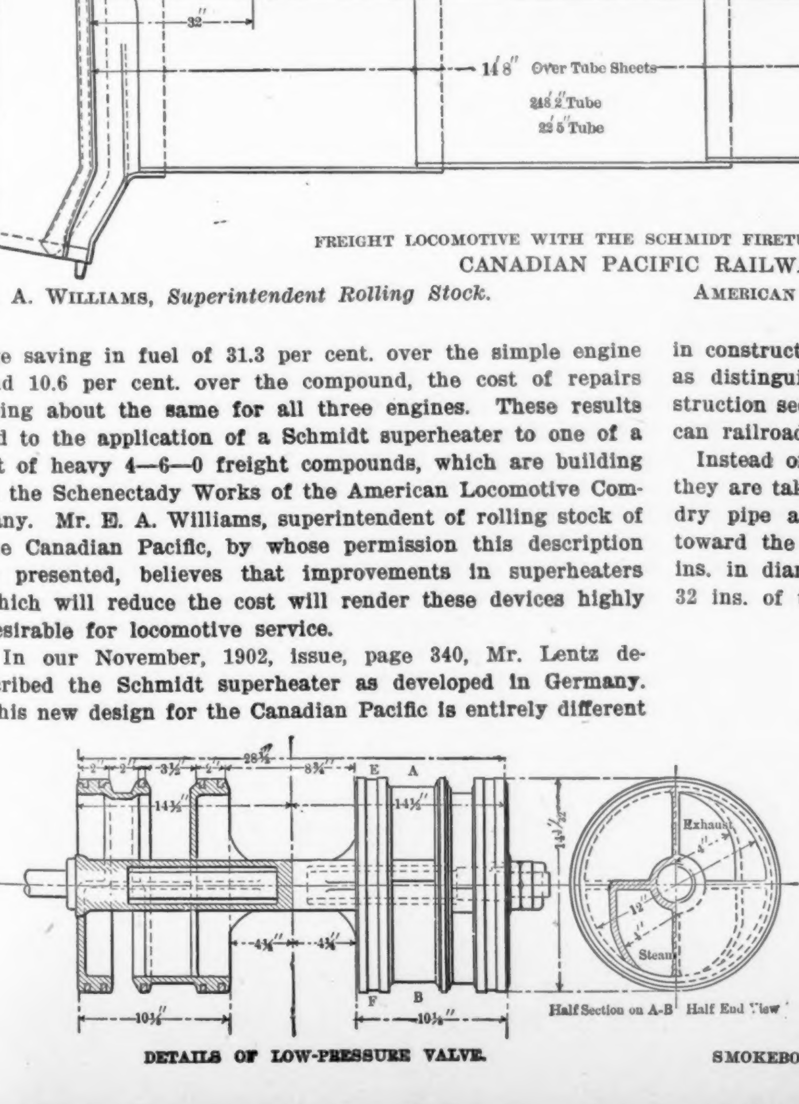


FREIGHT LOCOMOTIVE WITH THE SCHMIDT FIRETUBE SUPERHEATER.
CANADIAN PACIFIC RAILWAY.

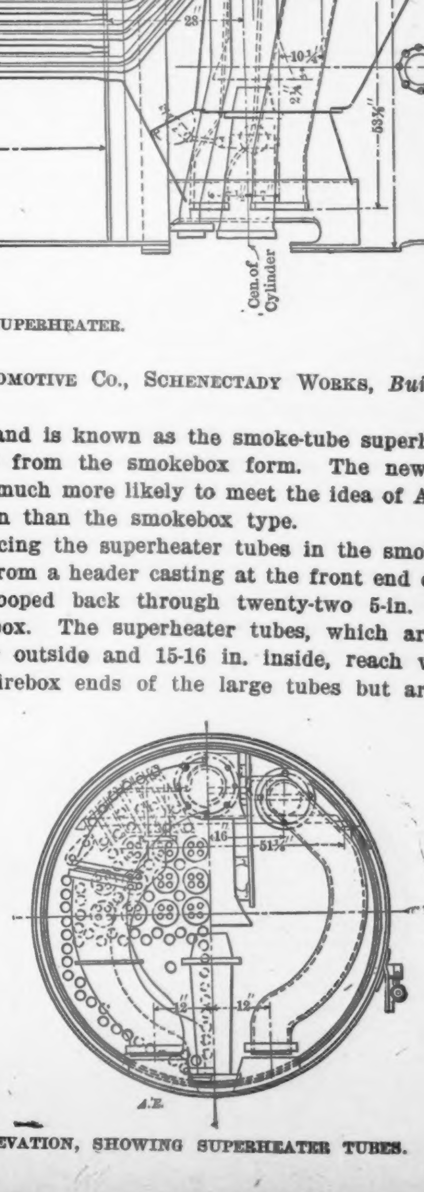
E. A. WILLIAMS, *Superintendent Rolling Stock.* AMERICAN LOCOMOTIVE CO., SCHENECTADY WORKS, *Builders.*

In our November, 1902, issue, page 340, Mr. Lentz described the Schmidt superheater as developed in Germany. This new design for the Canadian Pacific is entirely different in construction and is known as the smoke-tube superheater as distinguished from the smokebox form. The new construction seems much more likely to meet the idea of American railroad men than the smokebox type.

Instead of placing the superheater tubes in the smokebox they are taken from a header casting at the front end of the dry pipe and looped back through twenty-two 5-in. tubes toward the firebox. The superheater tubes, which are 1¼ ins. in diameter outside and 15-16 in. inside, reach within 32 ins. of the firebox ends of the large tubes but are not

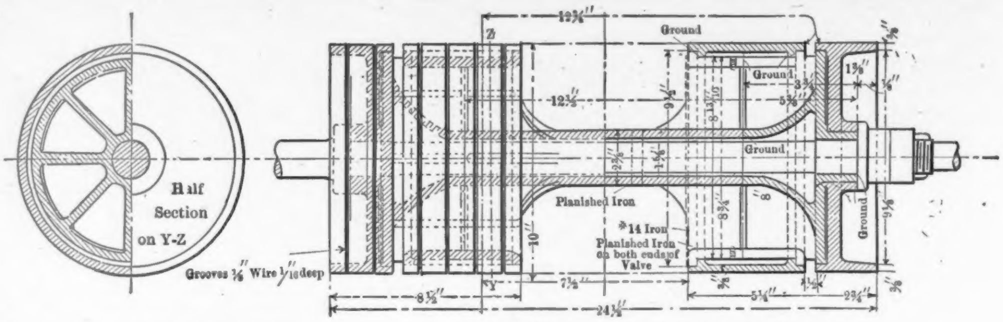


DETAILS OF LOW-PRESSURE VALVE.



SMOKEBOX ELEVATION, SHOWING SUPERHEATER TUBES.

exposed to the direct heat of the firebox. Return bends at the ends of the superheater tubes take the superheated steam forward again to the header, which is partitioned off to separate the hot from the cooler steam. From here the branch pipes take the superheated steam to the cylinders. In the engravings this interesting arrangement is indicated. The large tubes are swaged down at the back ends and beaded in the usual manner. Each large tube contains two loops of the smaller tubes, which are braced by feet cast upon the return bends at the back ends. At the header casting the loops are removably connected so that they may be easily taken down for examination and repairs. The superheater pipes are solid drawn steel tubes, the amount of heating surface thus provided being 289.5 sq. ft.



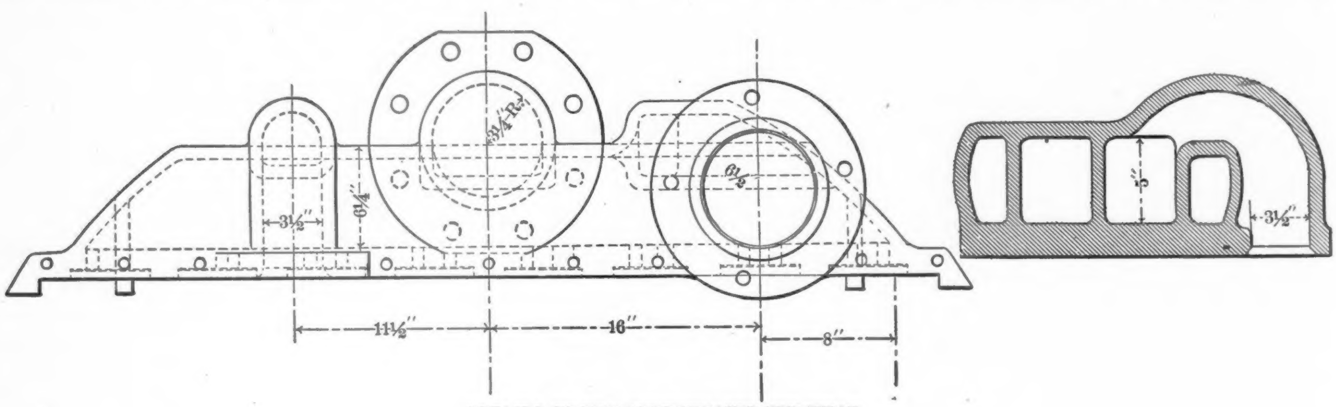
DETAILS OF HIGH-PRESSURE VALVE.

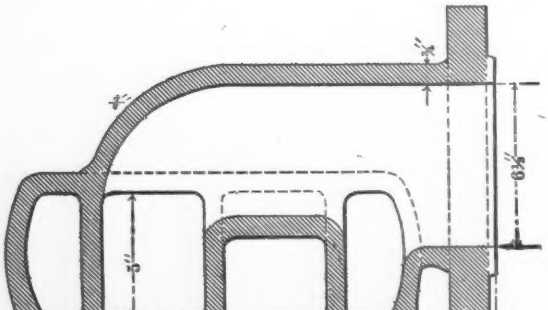
A plate partition separates the main portion of the smoke box from the space containing the superheater header and the tube ends. A flat damper valve connects the spaces and this valve is opened by the steam pressure in the steam pipes acting through a small cylinder shown on the side of the smokebox. When the throttle is open this valve is also open and it closes by action of a counterweight when the throttle is closed. With this device the superheater tubes cannot become highly heated when steam is not passing through them and thus the greatest danger of burnt tubes is avoided. It will be noted that with this construction the smokebox is necessarily long to receive the superheater header, but that its diameter is not enlarged as was required with the earlier construction of smokebox superheater. The header takes the superheater tubes in groups of four. A detail drawing on page 317 shows the manner of securing the tubes to the heater so that they may be easily removed. The steam-tight joints are made against copper wire gaskets. The detail drawing below illustrates the construction of the header and the arrangement of the partitions. Other interesting details of this design will be presented in future numbers of this journal.

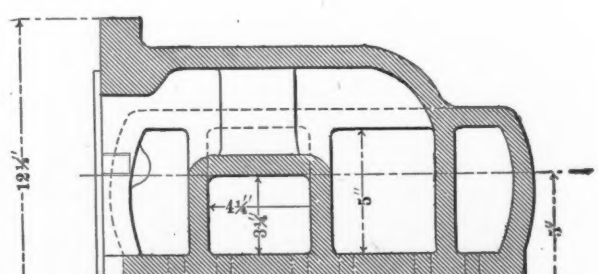
Both high and low-pressure valves are of the double ported piston type with internal admission. The low-pressure valve has L rings except the central ones on each side. The high-pressure valve is interesting in that it embodies unusual features to provide for the high temperature of the superheated steam. The packing rings are 5¼ and 2¾ ins. wide respectively, and are free to find their own bearings when the nuts are tight on the stem. They have no end movement, but adjust themselves laterally over the ground joints. The central cage has eight ⅜-in. ribs. The cage, ribs and central portion of the spindle of this valve are protected from the highly heated steam by planished iron shields, as indicated in the drawings. Cast iron is used in the construction of this valve. The drawing shows the locations of the packing grooves, which are ⅛ in. wide and 1-16 in. deep.

The small pipe leading from the T bend to the intercepting valve conveys saturated steam for starting the engine. The receiver and high-pressure steam pipe are arranged as usual.

This locomotive will be put into service on a division adjacent to Montreal and will be run opposite to another of the same class, without the superheater. No special test other


DETAILS OF THE SUPERHEATER TEE HEAD.


VERTICAL SECTION OF ABOVE THROUGH CENTRAL FLANGE.


VERTICAL SECTION OF ABOVE THROUGH FLANGE AT RIGHT.

FREIGHT LOCOMOTIVE WITH SCHMIDT FIRETUBE SUPERHEATER.

CANADIAN PACIFIC RAILWAY.

than a comparison of service from month to month will be made. Mr. Williams believes that the improvements which have been made since the application of the first superheater on this road will tend to reduce the cost of construction and also of maintenance. It is stated that one of the 4-6-0 compounds now building for this road at Glasgow, Scotland, is also to be equipped with the Schmidt superheater.

Compound Locomotive with Superheater.
4—6—0 Type.—Freight.
Canadian Pacific Railway.
General Dimensions.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	187,500 lbs.
Weight on drivers	138,500 lbs.
Weight engine and tender in working order	310,200 lbs.
Wheel base, driving	14 ft. 10 ins.
Wheel base, rigid	14 ft. 10 ins.
Wheel base, total	26 ft.
Wheel base, total, engine and tender	54 ft. 6 ins.

Cylinders.

Diameter of cylinders	22 and 35 ins.
Stroke of piston	30 ins.
Horizontal thickness of piston	L. p., 4⅛ ins.; h. p., 4¾ ins.
Diameter of piston rod	3¾ ins.
Kind of piston packing	Cast iron
Kind of piston-rod packing	Sullivan metallic

Valves.

Kind of slide valves	Piston
Greatest travel of slide valves	6 ins.
Outside lap of slide valves	H. p., 1¼ ins.; l. p., 1 in.
Inside clear of slide valves	H. p., ¼ in.; l. p., ⅜ in.
Lead of valves in full gear	L. p. 5-16-in. lead at 15-in. cut-off
Kind of valve-stem packing	Sullivan metallic

Wheels, Etc.

Number of driving wheels	6
Diameter of driving wheels outside of tire	62 ins.
Material of driving wheel, centers	Cast steel
Thickness of tire	3 ins.
Tire held by	Shrinkage
Driving-box material	Cast steel
Diameter and length of driving journals	9 ins. diameter x 12 ins.
Diameter and length of main crankpin journals,	Main side, 7½ x 4¾ ins., 7 ins. diameter x 6½ ins.
Diameter and length of side-rod crankpin journals,	5 ins. diameter x 4½ ins.
Section of rods	Main — I; side, I
Engine truck, kind	Four-wheel swing bolster
Engine truck, journals	6 ins. diameter x 10 ins.
Diameter of engine truck wheels	31 ins.

Boiler.

Style	Extended wagon top
Style	Ex. wagon top
Outside diameter of first ring	70½ ins.
Working pressure	210 lbs.
Material of barrel and outside of firebox	Central steel
Thickness of plates in barrel and outside of firebox:	¾, 13-16, ½, 1 and 9-16 in.
Horizontal seams	Butt joint, sextuple riveted
Circumferential seams	Double riveted
Firebox, length	102⅛ ins.
Firebox, width	70⅝ ins.
Firebox, depth	Front, 74⅛ ins.; back, 59½ ins.
Firebox, material	Otis steel
Firebox plates, thickness:	Sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube sheet, ½ in.
Firebox, water space	4½ ins. front, 3½ ins. sides, 3½ ins. back
Firebox, crown staying	Radial, 1⅛ ins. diameter
Firebox, staybolts	Taylor iron, 1 in. diameter
Tubes, material and gauge:	Charcoal iron, No. 11, I. W. G.; Shelby steel, 3-16th
Tubes, number and diameter	248 2 ins. and 22 5 ins.
Tubes, length over tube sheets	14 ft. 8 ins.
Heating surface, tubes	2,311.25 sq. ft.
Heating surface, firebox	171.92 sq. ft.
Heating surface, total	2,483.17 sq. ft.
Grate surface	49.82 sq. ft.
Grate, style	Rocking
Ashpan, style	Railway company's style
Exhaust pipes	Single
Exhaust nozzles	5¼, 5½ and 5¾ ins. diameter
Smokestack, inside diameter	14½ ins.
Smokestack, top above rail	15 ft. 2 ins.
Boiler supplied by	Two Hancock injectors, No. 10

Tender.

Style	Hopper
Weight, empty	52,700 lbs.
Wheels, number	8
Wheels, diameter	40 ins.
Journals, diameter and length	5½ ins. diameter x 10 ins.
Wheel base	16 ft. 9½ ins.
Tender frame	10-in. steel channels
Tender trucks	Simplex bolsters
Water capacity	5,000 gals., Imperial
Coal capacity	10 tons

Extensive improvements are at present under way on the Buffalo division of the Delaware, Lackawanna & Western. A large number of culverts and small bridges are being replaced by heavy plate girder steel bridges, with concrete piers, of the most substantial construction. Two long trestles over ravines have been replaced by permanent earth fills by relocations of the right of way. Also a system of block signals is being installed by the Hall Company to protect a 35-mile section of the road across a valley west of Dansville, where a heavy pusher-engine service is required; this will greatly facilitate the movement of trains over this important section of the road.

DISTRIBUTED COST OF CAR REPAIRS.

WITH TABLE.

This exceedingly valuable table represents the results of a very carefully kept record of the cost of car repairs on an important trunk line and covers the complete year of 1902. It was kept for the purpose of ascertaining definitely the relative cost of maintaining various parts, with a view of revealing the weaknesses of present wooden car construction in order to show what parts needed the greatest amount of immediate attention. For example, it has been said that draft gear repairs amounted to from 50 to 75 per cent. of the total repairs to freight equipment. This record shows that these repairs amount to less than 25 per cent. and that the parts above the floor—chiefly roofs—cover 29 per cent. of the total.

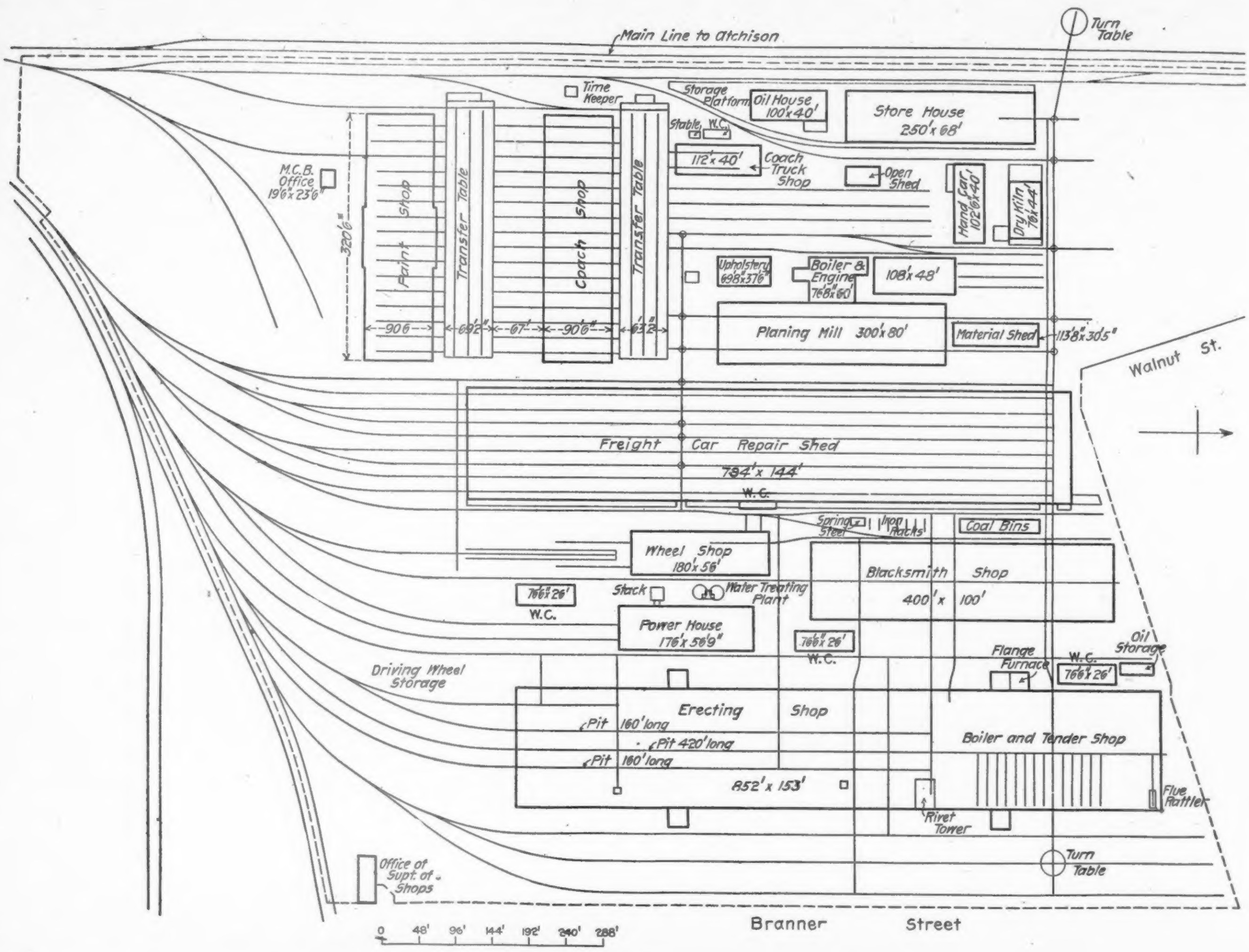
From this record we do not deem it safe to infer that because draft gear represents but 23 per cent. improvements in these parts are less important than those in roofs. The fact is that if friction draft gear is used the racking of roofs will be reduced, and the same is true in a measure of all other parts.

The total cost per car per year was $19.41. This and many other interesting facts are shown in the table.

COST OF CAR REPAIRS.

Average cost per car for repairs of freight cars, based on the year 1902.

Division.	A.		B.		C.		Foreign Cars.		Total.		
	Times repaired.	Cost per time repaired.	Times repaired.	Cost per time repaired.	Times repaired.	Cost per time repaired.	Times repaired.	Cost per time repaired.	Times repaired.	Cost per time repaired.	Percentage of total cost.
1—Couplers, complete	3,507	$1.76	6,431	$2.63	5,689	$2.63	9,995	$1.86	25,622	$2.21	12.68
2—Draft spring, followers, stops, pockets, spindles, etc.	3,657	1.05	3,190	1.07	7,887	1.19	6,893	1.10	21,627	1.12	5.44
3—Draft timbers, draft arms and bolts for same	1,922	2.43	2,688	1.47	5,942	.90	4,812	1.07	15,364	1.25	4.29
4—Uncoupling levers, brackets and chains	1,848	.27	1,424	.28	3,036	.27	1,135	.20	7,446	.27	.44
5—Body bolsters:											
(a) Metal	3	1.88	9	5.00	23	2.91	.....	....	35	3.23	.03
(b) Wooden	4	4.76	5	4.36	15	2.27	3	3.81	27	3.19	.02
6—Sills:											
(a) Center	154	9.74	270	10.46	574	9.11	2	12.27	1,0[illegible]0	9.58	2.15
(b) All other longitudinal sills	336	7.97	453	9.37	994	11.63	2	10.28	1,7[illegible]5	10.56	4.15
(c) End sills	312	4.20	674	2.90	1,141	2.63	29	2.99	2,1[illegible]6	2.94	1.00
7—Trucks:											
(a) Wearing parts, wheels, axles, bearings, etc.	1,571	7.47	3,608	4.53	2,875	4.33	11,482	4.54	19,536	4.74	20.78
(b-1) Metal bolsters	22	45.08	1	39.00	35	31.71	4	4.78	62	34.63	.48
(b-2) Wooden bolsters	297	4.26	651	4.09	1,259	3.32	395	4.14	2,602	3.75	2.18
(c) Fixed parts	6,394	,91	3,031								
8—Brakes:				.94	8,960	.99	7,269	.75	25,654	.90	5.15
(a) Foundation	9,569	.41	8,496	.66	10,320	.74	14,567	.53	42,952	.58	5.61
(b) Air	4,189	.67	5,238	.98	8,624	1.24	8,230	.80	26,281	.96	5.66
9—All other parts of car above floor	15,665	2.24	10,986	3.13	14,799	1.26	13,866	.80	60,316	2.16	29.52
Entire car	37,944	2.16	34,276	2.91	31,791	4.52	71,806	1.68	175,817	2.52	100.00
Cost per car per year, based on above											$19.41



GROUND PLAN OF THE NEW SANTA FE LOCOMOTIVE SHOPS AT TOPEKA.

INTERIOR OF LOCOMOTIVE ERECTING SHOP, LOOKING NORTH.

NEW LOCOMOTIVE SHOPS AT TOPEKA, KAN. —ATCHISON, TOPEKA & SANTA FE RAILWAY.

NEW LOCOMOTIVE SHOPS AT TOPEKA.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

I.

GENERAL PLAN AND LOCOMOTIVE-SHOP BUILDING.

The old shops of this road at Topeka and a proposed plan for extensions were illustrated and the arrangement of the buildings discussed in this journal in June, 1901. Increased facilities have been secured by building a new locomotive shop, including in one fine building the erecting, machine and boiler shops. In addition to this, a new blacksmith shop, power-house and accessories have been put up, the new plant having been put into service in March last. A capacity to repair 50 locomotives per month was planned. There are but two larger locomotive-repair shops in the country—those at Altoona and Reading; and one equal to it in size—at Roanoke, Va. In May forty locomotives were in the shop, 24 on the so-called "pits" and 16 for new fireboxes. In the month of April 30 engines were turned out, the plant having been put into service March 15.

This plant is the largest on the road, and its equipment is to provide for all fireboxes east of Raton, N. M., and north of Texas; also for general repair work to about 350 engines, besides helping out all of the other shops on the road for the heaviest work. Twenty-one days are allowed for new fireboxes and the general repairs usually accompanying such work, and 10 days for light repairs. About 130 fireboxes will be put in this year. Fast and ample crane service characterizes this shop. The easiest thing about the plant is to move material, heavy or light. About 1,650 men are employed in both locomotive and car departments and about 1,200 in the locomotive works alone. Considerable manufacturing is done here; for example, all axles for the entire system are made at Topeka, and this principle is being carried out in other departments of the shop by aid of a lot of up-to-date machinery.

The locomotive shop is selected for the first installment of this description. Special attention will later be given to the power-house, blacksmith shop, and the equipment of all the departments.

The erecting, machine and boiler shops are combined in a magnificent building 850 ft. long by 155 ft. wide. Continuous crane service extends the full length of the machine shop and through the erecting and boiler shops, which use the same cranes. A cross section of the building is given, and a complete ground plan will appear with the presentation of the equipment, showing tool locations. The section shows the height of the crane girders and the spans.

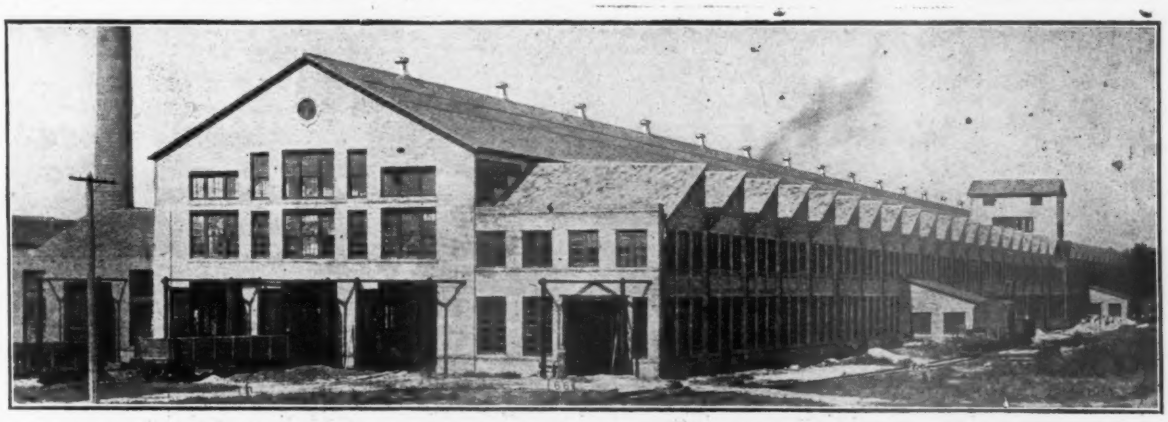
This is a "longitudinal" shop, and the arrangement permits of the utmost elasticity in the use of the floor space. There are three tracks at 23-ft. centers in the central or erecting-shop bay, which is 74 ft. wide. The central track has a pit extending 420 ft. from the south end, and the other tracks have 160-ft. pits. The rest of the floor is available for engines and has longitudinal tracks, but no pits. The engines are "staggered" in order to get room to take out flues and yet stand them close together. This plan seems to work out very well. The operation of the plant will be given in detail later.

The west bay is for heavy machinery, that on the east side for lighter machinery and tenders, and overhead at the south end is a gallery 525 ft. long for brass, tool and air-brake rooms and the tin shop. Near the center of the east bay is the riveting tower, which is 62 ft. high, to the crane rails. Both side bays have the weaving shed type of roof, the construction of which is clearly seen in the engravings. In the construction the steelwork was completed by itself. The engravings show the large amount of natural lighting and the portions of the walls which are built of brick. These are 13 ins. thick. The roofs are of Ludowici tile, and the skylights are of translucent fabric, 12 ft. wide. These extend on each side of the roof the full length of the building, and along the ridge Star ventilators are spaced at 50-ft. centers.

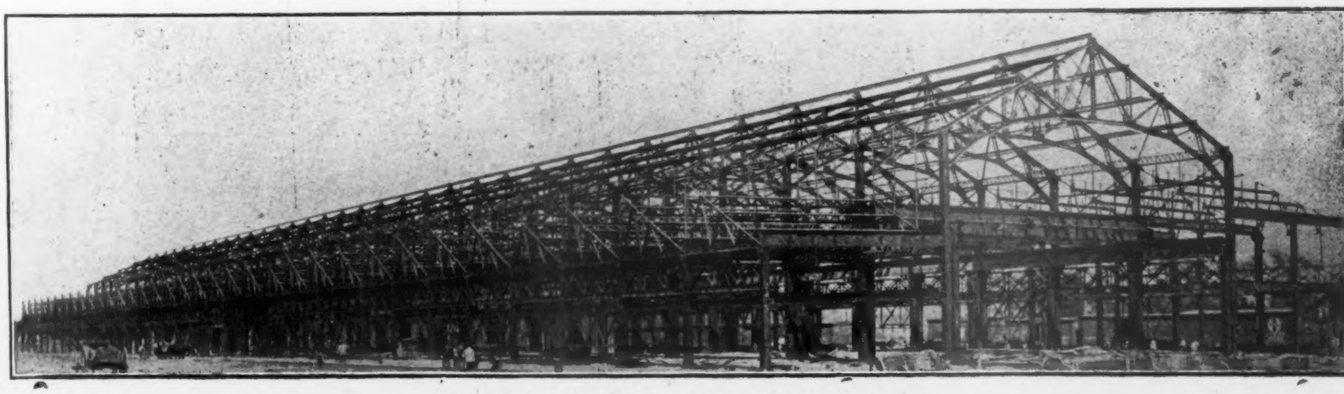
The crane and building columns are spaced at 25-ft. centers and supported on large concrete foundations. For the roof calculations the assumed loads were:

Snow	10 lbs. per ft.
Wind	25 lbs. per ft.
Covering	15 lbs. per ft.
Total	50 lbs. per ft.

The tension members were confined to 16,000 lbs. per square inch and the compression members to 14,000 lbs. The building

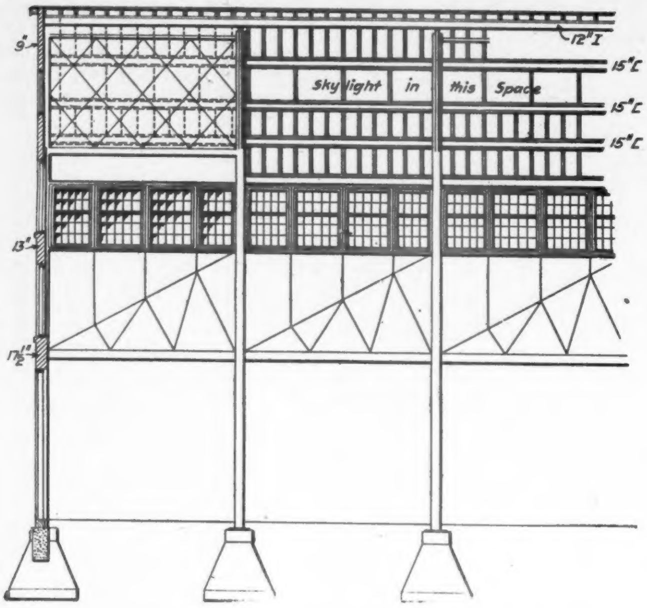


VIEW OF MAIN LOCOMOTIVE SHOP, FROM THE SOUTHEAST.

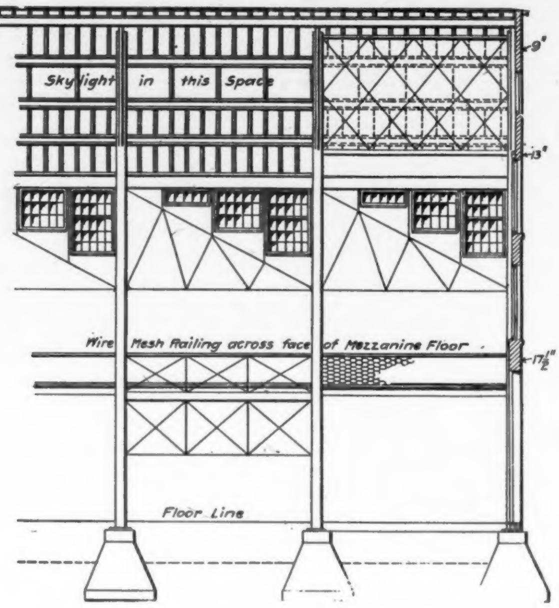


THE STEEL SKELETON OF THE LOCOMOTIVE SHOP.

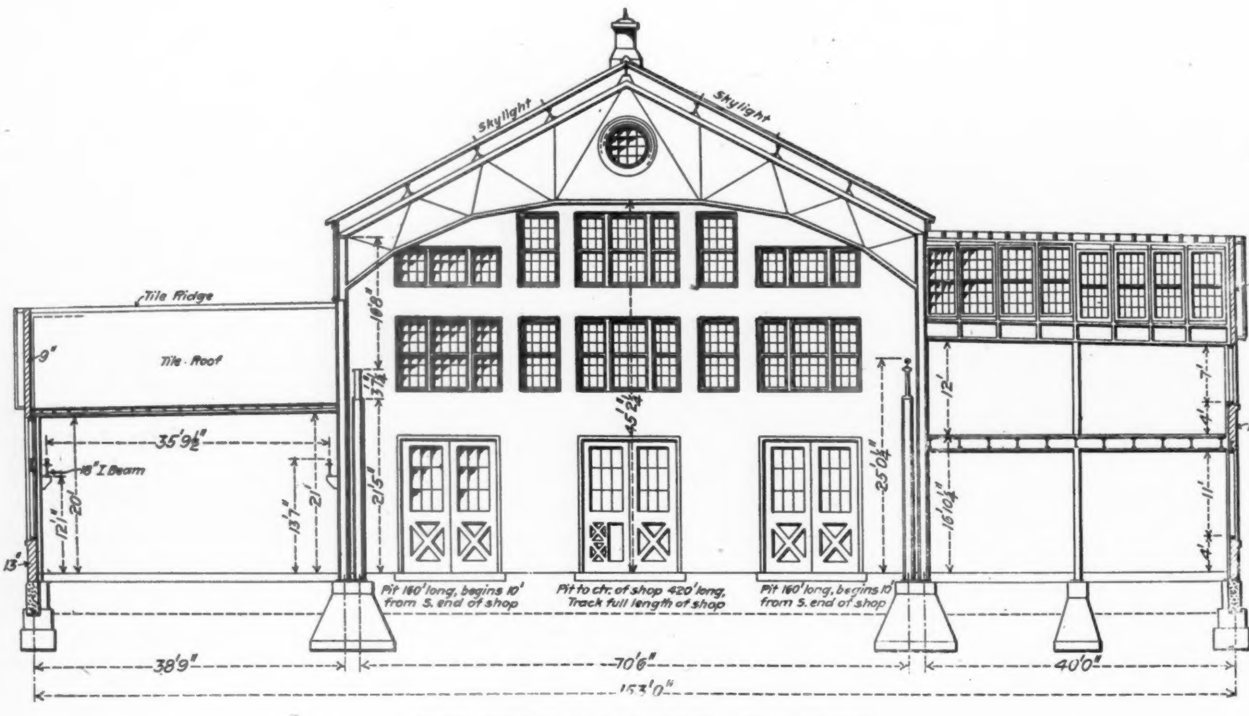
NEW LOCOMOTIVE SHOPS AT TOPEKA, KAN.—ATCHISON, TOPEKA & SANTA FE RAILWAY.



STEEL FRAME OF LOCOMOTIVE SHOP, WEST SIDE.



STEEL FRAME OF LOCOMOTIVE SHOP, EAST SIDE.



CROSS SECTION OF LOCOMOTIVE SHOP BUILDING.

NEW LOCOMOTIVE SHOPS AT TOPEKA, KAN.—ATCHISON, TOPEKA & SANTA FE RAILWAY.

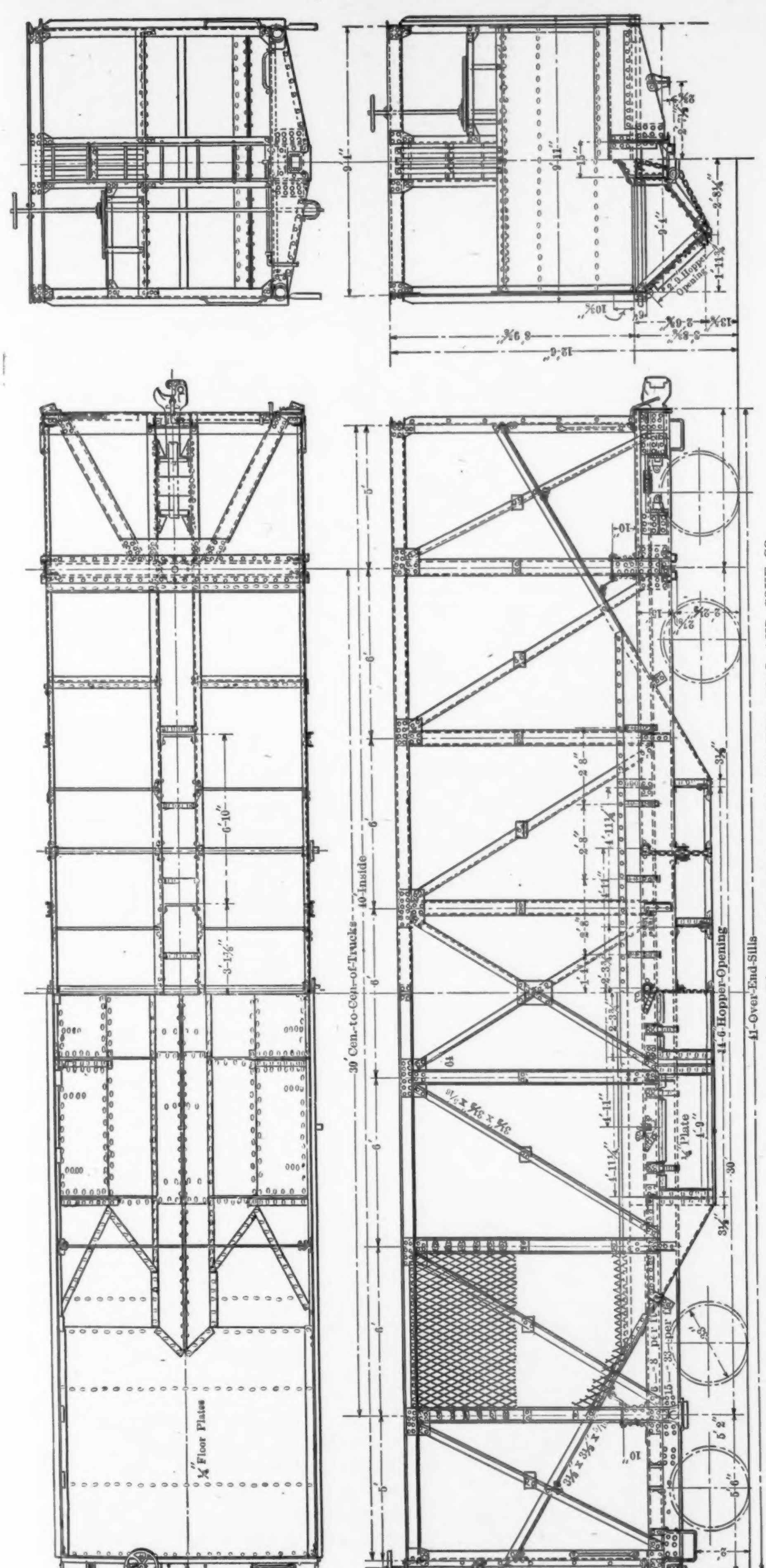
columns are built of 15-in. I-beams, in pairs, the main crane girders being supported on similar columns.

The floor is of concrete 6 ins. thick laid on the ground. On this are 2 x 4-in. timbers of yellow pine placed 18 ins. apart and covered with 2-in. tongued and grooved maple. The shop tracks are laid on pine ties treated with the zinc chloride process at the tie-treating plant of the company in New Mexico. The pits are of concrete, and the rails are placed on stringers. Where ties are used the concrete floor finishes up to the ends of the ties, which may be removed without disturbing the permanent floor.

These extensive improvements have been in preparation for several years. The buildings were designed and constructed under the direction of Mr. W. B. Storey, chief engineer, and Mr. A. F. Robinson, bridge engineer. The equipment of the shops and its arrangement were under the direction of Mr. G. R. Henderson, whose administration as superintendent of motive power began after the preliminaries and the buildings were provided. Mr. F. H. Adams, engineer of shop extension, was in charge of the machinery and installation, and the unusual state of efficiency of the new plant, which was practically in full working order in 30 days after it was put into service, is largely due to the careful preliminary plans for the reception of the machinery. Mr. John Purcell is superintendent of the entire plant at Topeka. Shops of this size need the individual attention of a specialist in shop administration, and other roads would do well to follow this example by removing such responsibilities from officers who have their attention fully occupied with the operation of locomotives on the road.

The power-house, electrical distribution, machinery, and operation of these interesting shops will be subjects of subsequent articles.

Company. The heating system was furnished by the B. F. Sturtevant Company, and the complete electrical equipment, for both lighting and power distribution, was furnished by the General Electric Company.



VANDERBILT 50-TON COKE CAR.—LACKAWANNA COAL AND COKE CO.

SOUTH BALTIMORE STEEL CAR AND FOUNDRY CO., *Builders.*

CORNELIUS VANDERBILT, *Designer.*

VANDERBILT 50-TON COKE CAR.

LACKAWANNA COAL & COKE COMPANY.

Coke cars are now being built to the design and under the patents of Mr. Cornelius Vanderbilt, by the South Baltimore Steel Car & Foundry Company, for the use of the Lackawanna Coal & Coke Company. The accompanying engraving illustrates the construction.

Length over end sills	41 ft. 0 in.
Length inside	40 ft. 0 in.
Width inside	9 ft. 4 ins.
Width outside of body	9 ft. 11 ins.
Height top of side to top of rail	12 ft. 6 ins.
Weight, light, estimated	37,000 lbs.
Capacity, 30 degs. heap	3,744 cu. ft.
Capacity, level	3,295 cu. ft.
Capacity, coke, 30 degs. heap	114,344 lbs.
Capacity, coke, level full	100,497 lbs.
Weight of coke, averages (cu. ft.)	38.5 lbs.

The sides are in the form of trussed girders, with diagonal braces of angles. The side sills are 6-in. 8-lb. channels and the center sills 15-in. 33-lb. channels. Six-inch 10½-lb. channels form the top chords, while the side sills form the bottom chords. The body bolsters are similar to those used in the Vanderbilt hopper coal cars for the West Virginia Central & Pittsburg Railway (AMERICAN ENGINEER, April, 1902, page 103). The bolsters are built up of two 10-in. 15-lb. channels, forming box girders resting on top of the center and side sills. Depending plates are secured to the webs of the center and side sills and the side bearings are secured to these plates. Floor plates ¼ in. thick are used throughout. Form, ⅜-in. frame diaphragm plates connect the side and center sills on each side.

Expanded metal is used for the sides and a saving of 25 per cent. in weight secured. This material was furnished by the New York Expanded Metal Company and has 3-in. meshes, the material being twisted and disposed in such a way as to supply lateral stiffness sufficient for this material. There is no stress upon the expanded metal except the side thrust of the coke. Riveted clips hold the expanded metal to the frame so that it cannot become loose. These are secured over turned-up edges of the metal.

The hoppers are arranged to dump at the sides of the car and a pair of doors may be operated simultaneously, to distribute the load, when desired. The load is dumped outside of the track. Three winding shafts operate the doors as indicated in the engraving. The slope of the main hopper floor is 30 deg. These cars are equipped with the Sessions-Standard Friction Draft Gear. The details of this design were developed by Mr. L. A. Shepard under the direction of Mr. Vanderbilt.

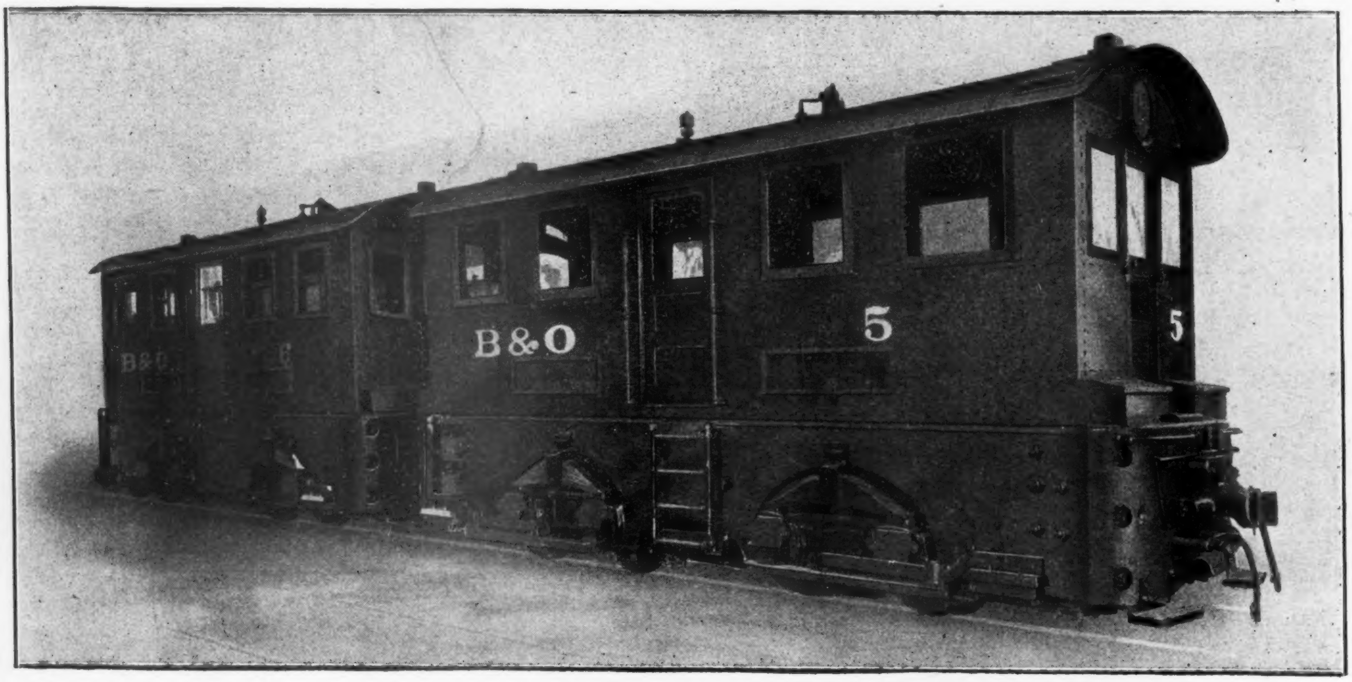
A NEW IDEA IN ELECTRIC LOCOMOTIVE DESIGN.

THE MULTIPLE-UNIT SYSTEM APPLIED TO HEAVY ELECTRIC TRACTION.

BALTIMORE & OHIO RAILROAD.

The General Electric Company has just turned out from its Schenectady Works an electric locomotive for the Baltimore & Ohio which is, in its entirety, the heaviest and most powerful locomotive ever built up to this time, whether steam or electrically propelled. It is intended for use in the peculiar class of service met in the Belt Line Tunnel of the Baltimore & Ohio at Baltimore, Md., where a third-rail system of electric traction has been in successful use for several years, as most of our readers well know.

The section of the Belt Line over which this locomotive will be operated extends from the Camden Street Station through the tunnel to the summit of the grade outside the tunnel, a distance of 3½ miles. It will handle all the freight traffice of the Baltimore & Ohio passing through Baltimore, in the same manner as the present electric locomotives, built by the General Electric Company, which have been in successful operation for the past eight years.



THE NEW MULTIPLE-UNIT ELECTRIC LOCOMOTIVE.—THE HEAVIEST AND MOST POWERFUL LOCOMOTIVE EVER BUILT.
BALTIMORE & OHIO RAILROAD. GENERAL ELECTRIC CO., *Builders.*

The specifications called for an electric locomotive capable of handling a 1,500-ton train, including the steam locomotive, but excluding the electric locomotive, on a maximum grade of 1½ per cent., at 10 miles per hour, with corresponding higher speed on lighter grades. This required a locomotive weighing approximately 160 tons on the drivers for purposes of adhesion, so that the engineers of the General Electric Company decided that the most practicable scheme was to build an articulated locomotive consisting of two complete 80-ton units operated together as one locomotive by means of the Sprague-General Electric multiple-unit system of control. The result has been the locomotive illustrated in the engraving, and it promises from the first trials to more than meet the expectations of the designers.

The entire locomotive consists of eight G.E.-65 motors, four in each half-section. These motors have each a capacity of 225 h.p., making the total capacity of the locomotive 1,800 h.p. Each section is equipped with the multiple-unit system of control and is so arranged as to permit it to be operated independent of the other, or to operate as well when several sections are coupled together. The controlling apparatus for each section consists of master controllers, engineer's valves, etc., in duplicate, a complete set being located in diagonally opposite corners of each cab, so that the engineer can stand in the front end of the locomotive when running in either direction.

The cab is large and roomy. The floor rests on the truck frame, the lining floor being of 1¾-in. hard pine, tongued and grooved, and the upper floor of hard pine, ⅞ in. thick, tongued and grooved and laid in the opposite direction. The sides and roof of the cab are of sheet steel. There is an entrance door on each side, and at each end there is an additional door which permits of ready communication between sections when coupled together. Large windows afford an unobstructed view in all directions.

Each section of the locomotive is equipped with a bell, a whistle, two locomotive headlights, Leach pneumatic track sanders and a complete air-brake equipment, including two engineer's valves and air gauges.

The main body of the truck frame consists of a rectangular framework of cast steel, built up strong and heavy, of four pieces, two side frames and two end frames. The parts are securely fitted by machining at the ends and bolted together, thus forming a very strong and rigid structure capable of withstanding the most severe shocks. The end pieces are very massive and form the buffer beams, and to which a standard draft gear is attached. The side frames have machined jaws protected by wearing shoes, between which the journal boxes slide.

The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half-elliptic springs, the ends of which are supported on top of the journal boxes through wearing plates. The journal boxes are made similar to standard car journal boxes, the parts, however, being larger and stronger. The brasses can be easily removed, and by dropping down the wearing shoes it is possible to remove a journal box complete without removing the wheels and axles or other parts of the truck.

In order that the locomotive may round curves easily, the axles are given considerable lateral movement in the journal boxes, it being practical to do this with the electric locomotive design and thus reduce the effective rigid wheel base. The wheels, axles or motors can be easily removed from the trucks by dropping into a suitably constructed pit or by raising the truck frame.

Each section of the locomotive has eight steel-tired spoked wheels. The tires are 2⅞ ins. thick, with M. C. B. standard tread and flange, and are securely held in place by approved fastenings. The axles are made of forged steel, turned throughout, 6 x 12 ins. in the truck journal-bearings, 8 ins. in the wheel fit and 7½ ins. in the motor bearings.

THE PROPER HANDLING OF THE TONNAGE RATING SYSTEM.

By R. S. Wickersham,

ASSISTANT ENGINEER OF TESTS, SANTA FE COAST LINES.

The question of tonnage and tonnage rating is one which has come rapidly into prominence in the last three or four years, and although much has been written on this subject in the technical papers and has formed the topic of discussion at many railway club meetings, still, on most railroads, it is far from being worked on a satisfactory basis at the present time. One of the principal troubles has been that, when the cry went up all over the country for a system of engine rating by the tonnage method, too many officials went into it without any knowledge of the subject and, in their zeal, made the tonnage heavier than has been found wise for the most economical results, both in engine and train service. Recently, however, a reaction has set in and the mistakes made in inaugurating the system are being slowly rectified.

One of the most important rectifications that is slowly being made in a great many parts of the country is that of abolishing the double-header system, the economy of which, the writer believes, has never been fully demonstrated.

It is a fact generally admitted that whenever a division yard gets "blocked" the superintendent runs singlehead trains and in a short time has the yard clear once more. Again, with the heavy power that is being built at the present time, the tractive force that is developed by two engines is enormous, and the numerous light capacity cars still in existence are unable to stand the strain, especially if near the head end of the train. The writer knows of cases where there were as many as twelve break-in-twos in a doublehead freight train in running over one division, each engine on this train developing 40,000 lbs. tractive force. In such cases the overtime would more than offset the saving in train crews' wages, to say nothing of the damage to equipment.

In a great many instances the rating of engines has been assigned to the operating department instead of putting it where it naturally belongs, viz., with the superintendent of motive power, who, if anyone, knows how hard an engine should be worked to obtain the most economical results and serve the best interests of the railroad company. One of the chief objections for leaving the rating of engines in the hands of the operating department, or, to put it where it generally goes, to the division superintendents, is that in their anxiety to make a good showing they lose sight of the importance of giving the engines a fair rating, which they can handle, and load the engines to such an extent that the overtime and engine failures more than compensate for the increased tonnage hauled.

The following is a little example illustrating the evils of overloading engines and showing its false economy: On a certain freight division of one of the large railroads there were 119 "dead freight" trains moved in both directions over the division during the month of August last. This does not include local, fast or time freights—nothing but "drag" trains being considered. Although the weather conditions during this month are extremely favorable, there were, during the month, 26 cases of stalling on hills and doubling, which amounts to nearly 22 per cent of the drag trains run. It is assumed that doubling a hill consumes, at a minimum, one hour's time. Also, that if each train should be reduced two cars, or 60 tons, it would be enabled to make an hour's better time between terminals. Permitting these assumptions, the 60 tons reduction per train for 119 trains would mean a total of 7,140 tons which must be handled in excess of the trains already considered, and on the division in question this tonnage would be run in five trains. The average time between terminals being ten hours, these five trains would consume 50 "engine hours." The time saved is one hour per train, by the reduction in tonnage made, and one hour saved for each double, as by the reduction suggested doubling would be abolished. This makes 119 and 26 hours, a total of 145 hours. Deducting from this the 50 engine hours required to handle the excess trains leaves a net saving of 95 engine hours. With the time saved nine trips over the division could be made, handling 13,500 tons of freight, this in excess of what could have been carried by the overloading method; or the time could have been spent on the engines in the roundhouse putting them in better shape. The saving in overtime, loss of fuel due to excessive forcing of engine and boiler, delays to other trains due to doubling and dragging these dead freight trains up hills are not noted here although they would prove to be an important factor in railway operation even if somewhat intangible.

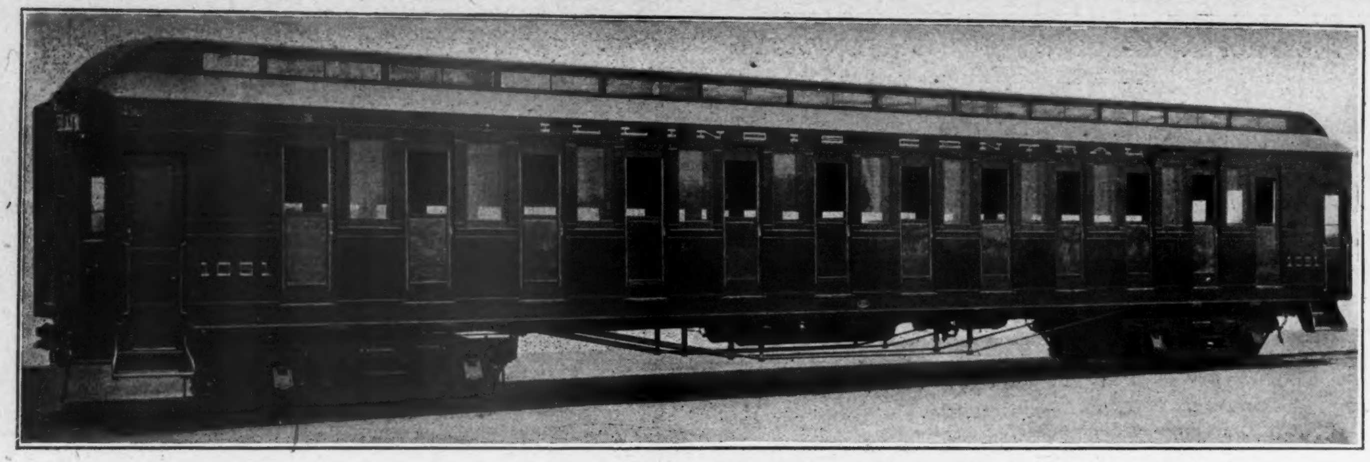
It is a well-known fact that the efficiency of an engine decreases rapidly as the boiler is forced. Professor Goss, in his experiments on Schenectady No. 1 at Purdue University, demonstrated that up to about three-fourths of the capacity of the boiler the water evaporated per pound of coal increased directly with the coal burned per square foot of grate area per hour. After this point is reached the evaporation falls off very rapidly. This is one of the points not considered by operating officials in establishing a rating and should be a good reason for taking that power out of their hands. A superintendent will load an engine so that all she can do is to drag the train along, forcing the engineer to work his engine about three-fourths stroke over a greater part of the division. Such work as this eats up the coal pile unnecessarily, it being the last 50 or 75 tons which the superintendent insisted upon putting in the train which compels the engineer to work his engine uneconomically.

Another thing to which very little attention is paid is that of making proper reduction of tonnage during inclement weather, whether due to wind, rain, ice or snow. As a rule, no attention is paid to the weather unless a regular tornado comes along and so forces itself upon the attention of the trainmaster or superintendent. General managers should insist that division superintendents have their dispatchers make a proper reduction of tonnage in bad weather. It is true that on most roads there are standing orders to this effect, but, like many another, they are usually made, not to be enforced, but to relieve managing officials of responsibility in case of possible trouble.

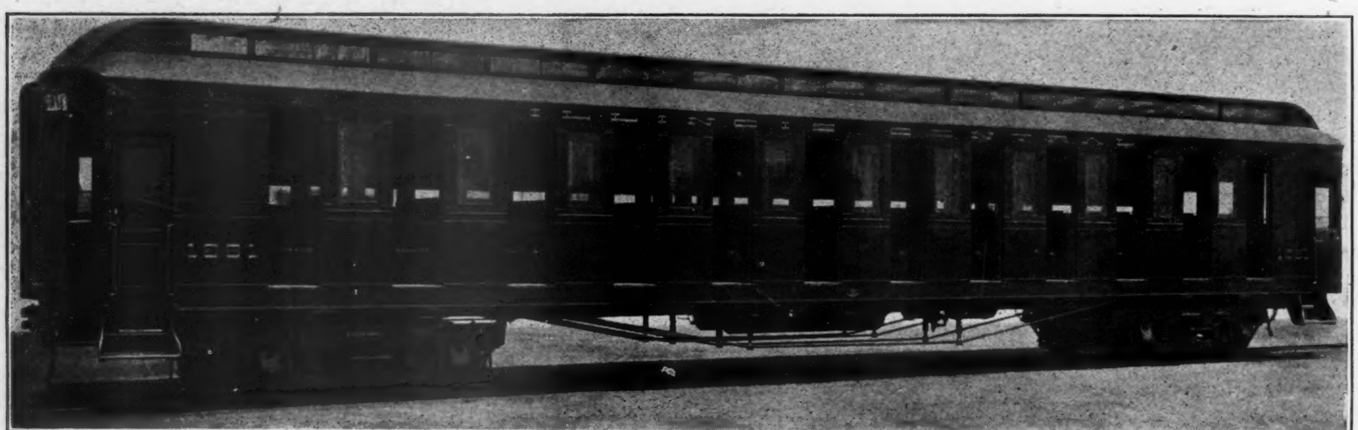
Nearly all operating officials will admit that there is no economy in overloading engines to such an extent as to cause overtime and engine failures, yet they go on in the same old way, doing these very things. One of the most successful general superintendents in this country, upon taking charge recently of a new territory, said to me, in effect: "My idea is this: to first get our through freight trains on time so that shippers can count on getting their freight as per our schedule, *then* we will see what can be done in the way of tonnage." In this connection I might say that the line with which the writer is connected recently increased the time of its through freight trains quite materially in order that shippers might be assured of getting their freight when promised.

The Southern Pacific Railway has inaugurated a system of tonnage rating along the right lines by appointing a tonnage rating committee, composed of the superintendent of motive power, engineer of maintenance of way and mechanical engineer. These gentlemen get out the tonnage rating sheets, and all the superintendent has to do is to make up the trains in accordance with the rate sheet made out for his division. Taking the actual rating of engines out of the hands of the superintendents eliminates to a great extent one important factor in the overloading of engines, viz., the rivalry between divisions, due to the desire to make the best showing.

The ideal as well as the most economical way to make tonnage rating a success is for the operating and mechanical departments to work together, and for superintendents to cease trying to make a record at the expense of the mechanical department. The moment a superintendent tries to save money by saving a dollar in train crews' wages, by adding on tonnage and thereby costing the mechanical department two dollars in overtime, increased coal consumption and wear and tear on the machinery—that moment he has ceased to serve the company's best interests and should be relieved.



GENERAL VIEW OF CAR, SHOWING ARRANGEMENT OF SIDE DOORS.



VIEW OF CAR WITH SIDE DOORS OPEN, INDICATING LARGE EXIT CAPACITY.

INTERIOR VIEW OF CAR TO SHOW CENTRAL ARRANGEMENT OF SEATS.

NEW STEEL-FRAME, SIDE-DOOR SUBURBAN PASSENGER CARS.—ILLINOIS CENTRAL RAILROAD.

DESIGNED BY A. W. SULLIVAN AND WILLIAM RENSHAW.

STEEL FRAME SIDE-DOOR SUBURBAN PASSENGER CARS.

Illinois Central Railway.

II.

The interesting newly designed suburban passenger cars for the Illinois Central, which were described at length in our June, 1903, issue (pages 204-206), have recently been completed and are to be immediately placed in service in the important suburban service at the Chicago terminal. We are permitted to present photos herewith showing the general appearance of the exterior and interior of this interesting and novel design of car.

The unusual interest which attaches to these suburban passenger cars is due not entirely to the novel mechanical features developed in their design and construction, but even more to the effect this type of car is likely to have upon the question of the safe, rapid and efficient transportation of a dense passenger traffic, and especially to the protection against fire, resulting from the exclusive use of steel in the underframe. This question has become such an urgent one in all large cities that public interest is immediately concerned in any solution that offers intelligent and practical means of relief from the discomfort and dangers incident to the use of the end-door type of car of wooden construction, which, with all its other disadvantages, gives to the public the minimum of seating accommodation, with the slowest possible service in receiving and discharging passengers.

As indicated in the above mentioned article, the English idea of a side-door is used, but the method of its application is quite different; and, while utilizing the side-door principle, there is combined with it all the advantages of the central aisle peculiar to the American end-door car, thus producing a type of car having the advantages of both systems without their disadvantages, and of much greater seating capacity.

In this country, with the steadily increasing density of passenger traffic upon railroads having a suburban business, and particularly upon the elevated and subway lines handling a heavy metropolitan traffic, the limitations of the end-door cars have become too plainly apparent, as demonstrated by the unreasonable detentions of trains at stations in discharging and taking on passengers during the rush hours of the morning and evening. These detentions have a material influence in diminishing the earning capacity of the properties, to say nothing of the inconvenience to the public occasioned by the inability of the lines to afford the requisite accommodations. The remedy usually applied of increasing the number of trains at such times does not afford the desired relief, for the reason that no improvement can thus be effected in the crowding of passengers at the ends of the cars, with the incidental struggling efforts of many persons to gain immediate entrance through the narrow gateways and end-doors. The entire system is a defective one and must necessarily remain so, as it produces a concentration of passengers at the ends of cars and congests the passageways whenever the traffic becomes heavy, and the congestion continues to increase with the density of traffic until finally the blockade is complete and movement ceases.

In these circumstances it is evident that the remedy lies in preventing the formation of the crowded groups at the ends of cars, and of distributing the passengers evenly over the entire length of the station platform, so that when trains arrive they may step directly and conveniently from the platform to the side-doors of the cars and avoid the uneasy movement up and down the platform to get opposite the end entrances at their more or less uncertain points of stoppage. Such distribution can be effected only by the use of cars having a sufficient number of side-doors so that there is no choice of position on the station platforms when awaiting trains. This result is obtained only in these new cars, which have 12 sliding side-doors on each side, each door being directly opposite a section of eight seats and spaced 5 ft. from center to center throughout the length of the car, which also has double aisles located on both sides just inside of the doors and extending the entire length of the car.

The numerous advantages of this method of transportation are shared alike by the passengers and the company. The absence of the crowding and the necessary struggling to gain entrance to the car, and the nearly double number of seats readily accessible than are to be found in an ordinary car, are changed conditions readily appreciated by the passengers, while the rapidity of the movement of receiving and discharging passengers will materially facilitate train movement and increase the transportation capacity of the road. As between an end-door and a side-door car the relative quickness of movement in receiving and discharging passengers is represented by the relation of the length to the width of the car and the number of doors available. In a car 60 ft. in length with two end-doors, passengers may leave the car in a single file at the rate of one per second from each door, requiring 30 seconds to empty the car, whereas in a car 10 ft. in width with 12 side-doors, passengers may leave the car at the rate of one per second from each door, requiring but 5 seconds, or one-sixth of the time to discharge the same number of passengers.

When in addition to these advantages, to the fireproof qualities, and to the impossibility of telescoping in case of collision, it is considered that the steel-frame car is from 6,000 to 10,000 lbs. lighter than cars of the same size of the standard wooden construction, it will be readily seen that a great advance has been made not only in the art of car construction, but what is perhaps of greater importance—it makes possible a pronounced improvement in the methods of passenger transportation.

This new type of car is the result of careful study, based upon long experience in the handling of a large suburban traffic on the part of Mr. A. W. Sullivan, assistant second vice-president, and of Mr. William Renshaw, superintendent of machinery, of the Illinois Central Railroad, who have designed the many original features embodied in these new cars, and to whom we are indebted for this information. Further interesting details of the cars will appear in our next month's issue.

AMERICAN ENGINEER TESTS.

LOCOMOTIVE DRAFT APPLIANCES.

Report by Professor W. F. M. Goss.

XIX.

(*Concluded from Page* 304.)

The stacks and nozzles experimented upon are shown by Fig. 107. The stack was made of sheet iron in such form as to slide within one of the bases which had been used in connection with the previous work. Set screws inserted around the lower part of the base assisted in centering the stack, and after each adjustment in height, the joint between the stack and the base was carefully packed to avoid leakage. In its highest position the top of this stack was at the same point as that reached by the "D" stack employed in experiments with outside stacks. The length of the straight portion was constant and equal to 58 ins., the total length including the flaring portion at the lower end being 64 ins. In the course of the experiments, the position of this stack was changed from the highest, as shown, to positions 10, 20 and 30 ins. lower, bringing its upper end to a position agreeing with the top of the outside stacks C, B and A, respectively. It should be noted that throughout the experiments, the total length of the stack tube remained unchanged, and also, that no change was made in the flaring portion at the bottom.

The use of an inside stack pre-supposes a low nozzle, and for this reason, three heights of nozzle only were experimented upon, namely, No. 3 nozzle, the tip of which is on the center of the boiler; No. 2 nozzle, the tip of which is 5 ins. lower; and

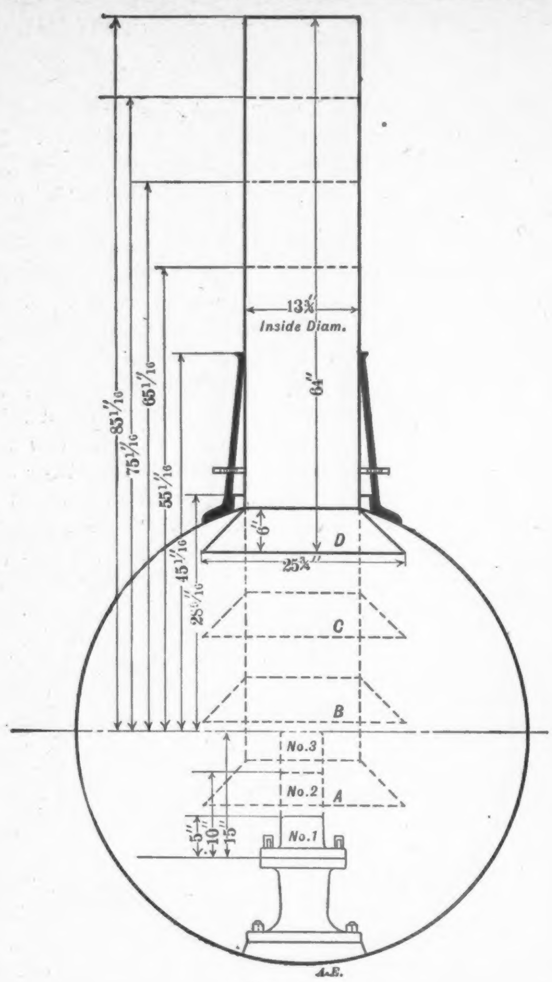


Fig. 107.

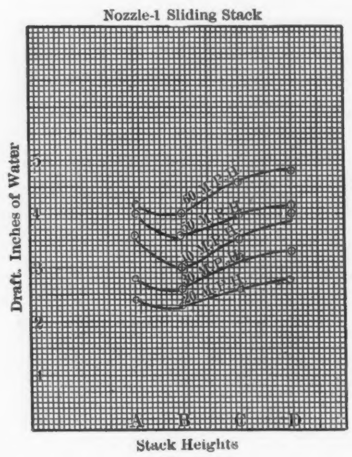


Fig. 108

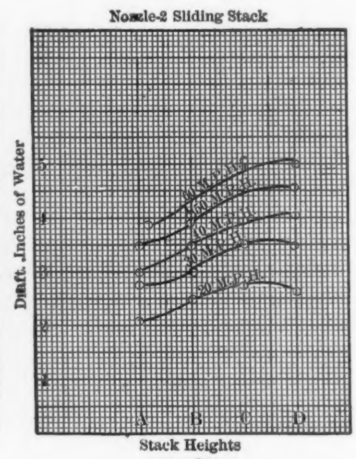


Fig. 109

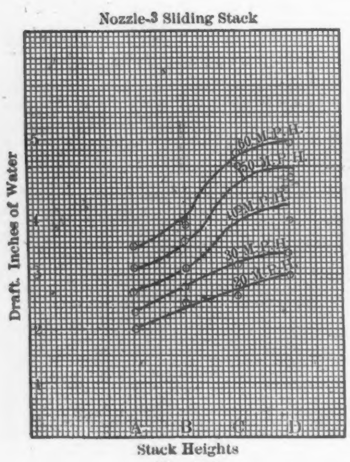


Fig. 110

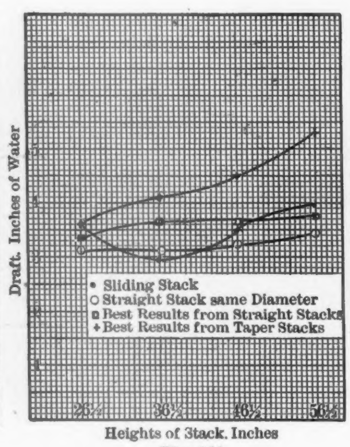


Fig. 111

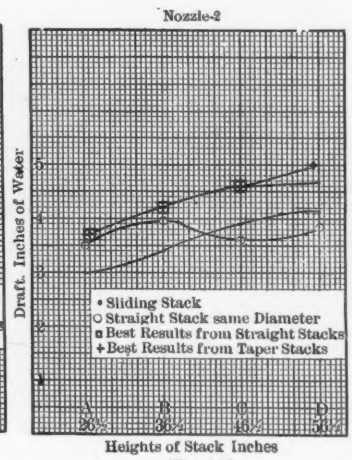


Fig. 112

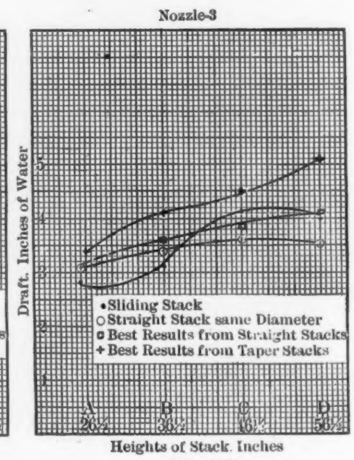


Fig. 113

No. 1 nozzle, the tip of which is 10 ins. lower. Tests were made in connection with each height of nozzle for each position of the stack. Only one diameter of stack was experimented upon. The results obtained for speeds of 20, 30, 40, 50 and 60 miles, respectively, are given in Tables VI. to XIII., inclusive, and are shown graphically in Figs. 108, 109 and 110.

Referring first to Fig. 108, representing results obtained from the lowest nozzle, it will be seen that the draft was best when the stack was at its highest point, and that it diminished as the stack was lowered, until in the process of lowering the stack, its lower edge approached very close to the exhaust nozzle. For the lowest position of the stack, for which but a trifle more than an inch intervened between the lower edge of the stack and the top of the nozzle, there is an increase in the draft value. Fig. 109, showing the results obtained in connection with the No. 2 nozzle which, for the lowest position of the stack, is actually inside of the stack itself, gives results somewhat similar. Fig. 110 is perhaps most interesting in comparison with Fig. 108. In Fig. 110, the exhaust nozzle is on the center line of the boiler, and the distance between the top of the exhaust nozzle and the base of the stack when the latter is in its highest (D) position, is the same as that between the lowest exhaust nozzle and the base of the stack when the latter was in its position (C). It appears, however, that notwithstanding this agreement between the relative position of tip and base of stack, draft values are higher for the higher tip (Fig. 110). Again, with this tip and the third position of the stack (B) we have the same relative position of tip and stack as existed between the lowest nozzle and the lowest position of stack (A), so that, if much depends upon the relative position of stack and tip B, results in Fig. 110 should agree with the A results in Fig. 108, and as a matter of fact, there is a rather close agreement in these results. Finally, it is of interest to note that with the highest tip and the lowest stack, when the tip is well into the body of the stack (position A, Fig. 107), draft values are less satisfactory than under any other condition.

The general conclusion to be derived from these results is to the effect that in changing the amount which the stack projects, it is not possible to maintain a constant stack efficiency by allowing the stack to project into the boiler to an amount equal to the reduction in its outside length.

We may next inquire whether there is any advantage in allowing the stack to project inside the boiler, as compared with results obtained with varying lengths of stack outside. For this study, reference should be made to Figs. 111, 112 and 113, upon which are plotted results obtained at a speed of 40 miles an hour; first, from the sliding stack; second, from a straight stack of the same diameter and of a height equal to the outside projection of the sliding stack; third, from the best results obtained from any straight stack of the height specified, the diameter agreeing, or not agreeing with that of the sliding stack; and, fourth, the best results obtained from a tapered stack of the several heights specified, regardless of its diameter. To properly interpret these results, one needs to construct, either actually or mentally, a picture of the stack conditions applying in each case. It will be of general interest to note that the outside straight stacks experimented upon were

not sufficiently large for results of maximum efficiency except for the very shortest length employed. In view of this fact and in view, also, of the fact that the straight stack of the same diameter when used in the B, C and D heights did not give as good results as straight stacks of greater diameter, it may be questioned whether the diameter of the sliding stack was well chosen for maximum results. It is clear, however, that the results as shown by Figs. 111 to 113 do not constitute a strong argument for the inside stack, since better results are obtained for straight stacks of the same diameter when the latter are of short length, and since it is shown to be easily possible to so proportion the diameter and length of an outside stack, even when the projecting heights are necessarily small, as to give better results than those representing the inside stack.

While the conclusion thus presented seems to be fairly justified by the experimental data, it should not be accepted as conclusive. The problem of the inside stack is one of many variables. The work already accomplished hardly does more than to suggest the difficulties to be met in reaching a satisfactory conclusion. Before the inside stack can be solved, much attention will need to be given to its form at the lower end.

It should further be noted that it is the practice of many roads using inside stacks to construct a false top to the smokebox, thereby imposing such conditions as to make the stack in effect entirely an outside stack. This is a condition which should be embraced by a further study of the subject, and until experiments can be conducted, which can involve as liberal a plan as that which has now been completed upon outside stacks, it will be rather unsafe to predict performance. Meantime, the writer would say that his discussion before the Master Mechanics' Association in June concerning the advantages of the inside stack, which was based upon a preliminary and altogether superficial study of the data, seems not to have been entirely justified.

[EDITOR'S NOTE.—At this point the report was interrupted in order to present the formulæ in the June issue.]

SECTION IX.

50. *Acknowledgments.*—Having now completed the description of this research it is fitting that some specific mention be made of those who have been concerned with its advancement. The locomotive laboratory of Purdue University was installed primarily for the instruction of students. As it is an expensive plant to operate, and as the trustees of Purdue have had but little money which could be used in meeting laboratory expenses, it has been found impracticable to keep the plant continuously occupied. It has in fact been idle approximately two-thirds of the time throughout its eleven years' existence. Being impressed with the importance of results which are to be obtained by its use, the undersigned has made repeated efforts to prolong its working periods. When, therefore, the AMERICAN ENGINEER proposed an important research, with a pledge covering the cost of same, its offer was promptly and gladly accepted. The research contemplated has long since been finished and all results have now been published. Viewing the undertaking as one of scientific achievement, it is evident that a large part has been taken by the AMERICAN ENGINEER, and it is to this journal, therefore, that formal acknowledgment should first be made. Not only has the AMERICAN ENGINEER supplied funds sufficient to meet all ordinary expenses incident to the active operation of Purdue's locomotive laboratory for the larger part of a year, but it has opened its columns to a long and somewhat technical report, reproducing with a lavish hand all figures and diagrams which have been submitted for its consideration.

It is fitting, also, that reference be made to the indulgence extended by the editor of the AMERICAN ENGINEER. In the prosecution of the work difficulties were encountered which could not have been foreseen. The undertaking was not of sufficient extent to warrant an increase in the permanent staff of the laboratory nor has it been practicable to employ outside expert assistance. As a consequence, the work was entirely assumed by an organization previously heavily loaded with routine work, upon some members of which the burden has borne heavily, with the result that while the tests were run with reasonable promptness, the task of summarizing data and formulating the report proceeded more slowly, so slowly, in fact, that more than a year has elapsed between the initial steps of the experiments and the completion of the concluding portion of this report. While the editor has not complained, it is evident that there can be no justification for such delay except such as may be found in the necessities of the situation.

It is but proper to mention, also, that while the AMERICAN ENGINEER proposed and executed, and has done this most liberally, the authorities of the university, also, in prescribing the conditions under which the tests were to proceed have in effect made important contributions to its progress. To the trustees of Purdue University, therefore, much credit is due.

The undersigned is especially indebted to Prof. Edward E. Reynolds, under whose immediate direction the work of the laboratory was carefully and vigorously advanced, and who, more than any other, has devoted himself to the work of summarizing data, and in drafting portions of the report; also, to Professor William Forsyth, who, while associated with the university, gave generous attention to all matters of design, and whose special study of existing stacks, as presented in a section of this report, is elsewhere acknowledged. Credit is also due members of the senior class of "'02" in the department of mechanical engineering, who, as expert observers, assisted in manning the laboratory, and especially to Messrs. E. Brock, L. Huxtable, J. P. Cook and J. C. McGrath, who presented graduating theses covering some portion of the investigation, the result of whose labors has been of material aid to the undersigned in the preparation of this report.

Others who have contributed to the success of the work, but who perhaps have rendered their aid more directly to the AMERICAN ENGINEER than to the undersigned, are as follows: The Lake Shore & Michigan Southern Railway Company, by the courtesy of Mr. W. H. Marshall, general superintendent, in supplying the experimental stacks and nozzles; the Snow Steam Pump Works in supplying oil-feeding device; the Standard Oil Company for the loan of oil tank and for courtesy in connection with supplying fuel oil; the Atchison, Topeka & Santa Fe Railway Company, by Mr. G. R. Henderson, superintendent of motive power, for supplying oil burner; and the Claybourne Oil Burner Company, 1770 Old Colony Building, Chicago, Ill., for supplying oil burner.

Respectfully submitted,

W. F. M. GOSS.

Engineering Laboratory, Purdue University, Jan. 10, 1903.

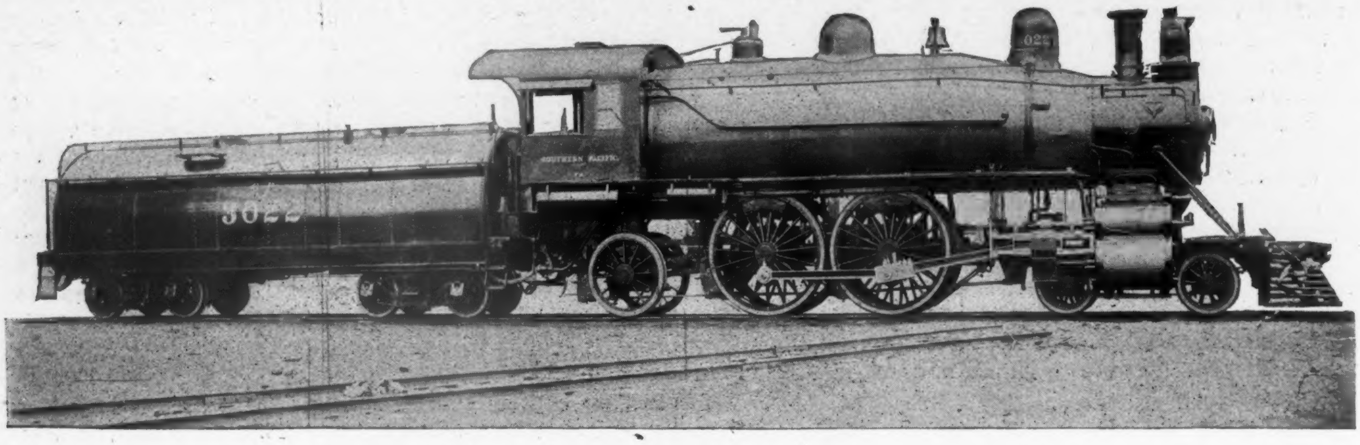
[EDITOR'S NOTE.—This is the conclusion of the report by Professor Goss and completes the record of the tests up to date.

OIL-BURNING PASSENGER LOCOMOTIVE.

VAUCLAIN COMPOUND 4—4—2 TYPE.

SOUTHERN PACIFIC RAILWAY.

This is the first locomotive of the 4—4—2, or Atlantic, type from the Baldwin Locomotive Works having the main road connected to the leading driving wheels. The wheel base for the locomotive alone is 31 ft. 3½ ins., which is longer than that of any other four-coupled locomotive in our record. Its total wheel base of locomotive and tender is 65 ft. 5¼ ins., which is more than 3 ft. longer than the wheel base of the two enormous decapods of the Santa Fe. The new Southern Pacific engine has a Vanderbilt firebox, arranged for burning oil and containing a departure in the form of a water leg at the back end of the firebox. The back end of the boiler tapers sharply to the back head, whereby considerable weight is saved and the cab is made more roomy. This road has adopted semi-circular tanks for the tenders of oil-burning engines. The one shown in the engraving carries 7,300 gals. of water and 3,300 gals. of oil. The construction of



NEW OIL-BURNING PASSENGER LOCOMOTIVE.—SOUTHERN PACIFIC RA ILWAY.
VAUCLAIN COMPOUND.—4-4-2 TYPE.

these tenders was illustrated in this journal in November, 1902, page 350. The wheel base of this tender is 24 ft. 4 ins.

The tractive power as a compound is 21,690 lbs., and with the starting valve open it is increased to 24,000 lbs. The following are the ratios or capacity factors, and the appended table presents the leading dimensions:

RATIOS.

Heating surface to volume of high-pressure cylinder	= 531.
Tractive weight to heating surface	= 33.6
Tractive weight to tractive effort	= 4.71
Tractive effort to heating surface	= 7.14
Tractive effort × diameter of drivers to heating surface	= 564.
Heating surface to tractive effort	= 14%
Total weight to heating surface	= 65.8

4—4—2 Type Passenger Locomotive.
Southern Pacific Railway.

Gauge	4 ft. 8½ ins.
Cylinder	15 ins. and 25 ins. x 28 ins.
Valve	Balanced piston
Boiler—Type	Wagon top
Material	Steel
Diameter	66 ins.
Thickness of Sheets	11-16 and ¾ in.
Working pressure	200 lbs.
Fuel	Oil
Firebox—Material	Steel Vanderbilt
Length	121 ins.
Diameter	63⅜ ins.
Thickness of tube sheets	½ in.
Tubes—Material	Steel. Wire gauge, 125 mm.
Number	346
Diameter	2 ins.
Length	16 ft.
Heating Surface—Firebox	155 sq. ft.
Tubes	2,883 sq. ft.
Total	3,038 sq. ft.
Driving Wheels—Diameter outside	79 ins.
Diameter of center	72 ins.
Journals	9 x 12 ins.
Engine Truck Wheels (Front)—Diameter	36¼ ins.
Journals	6 x 10 ins.
Trailing Wheels—Diameter	54¼ ins.
Journals	8½ x 12 ins.
Wheel Base—Driving	6 ft. 10 ins.
Rigid	15 ft. 10 ins.
Total engine	31 ft. 3½ ins.
Total engine and tender	65 ft. 5¼ ins.
Weight—On driving wheels	102,190 lbs.
On truck, front	61,620 lbs.
On trailing wheels	36,220 lbs.
Total engine	200,030 lbs.
Total engine and tender	About 340,000 lbs.
Tank—Capacity	Water, 7,300 gals.; oil, 3,300 gals.
Tender—Wheels	Number, 8; diameter, 33½ ins.
Journals	5½ x 10 ins.

MACHINE TOOL PROGRESS.

FEEDS AND DRIVES.

IX.

BY C. W. OBERT.

Another interesting variable-speed driving mechanism for a radial drill is illustrated in this article. The Mueller Machine Tool Company, Cincinnati, Ohio, have appreciated the importance of providing a wide range of speeds for the drive upon their drill, the result being the interesting variable-speed device described below. By means of this mechanism and the spindle back-gear the operator of the Mueller radial has at his command a range of 16 different speeds, all easily obtainable.

The new speed-box is illustrated in the engraving, Fig 44,

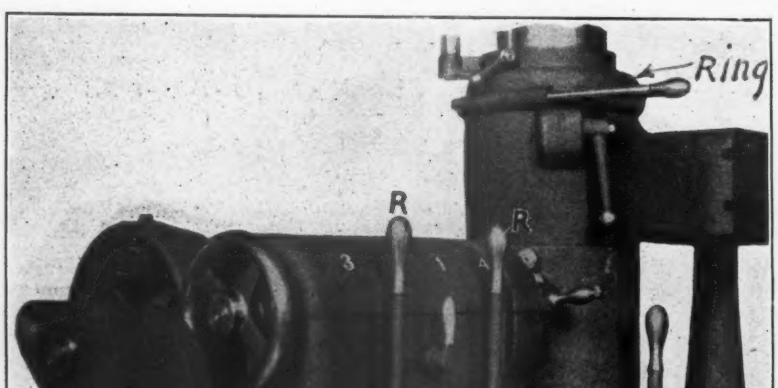


FIG 44.—VIEW OF THE SPEED BOX APPLIED IN CONJUNCTION WITH AN ELECTRIC DRIVE TO THE MUELLER RADIAL DRILL.

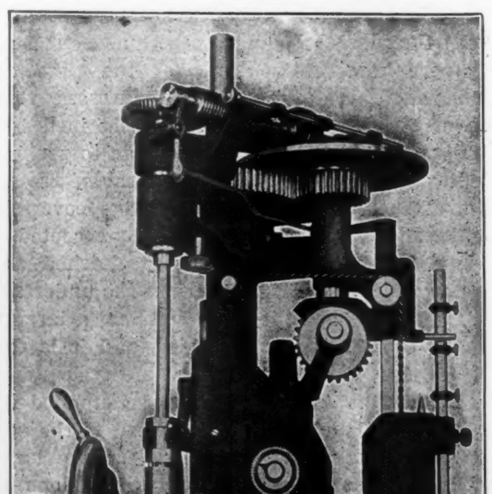


FIG. 46.—END VIEW OF HEAD UPON ARM, SHOWING FRICTION-PLATE FEEDING MECHANISM.

on the opposite page, in which the drive shown for the drill is an electric motor operating through a gear train enclosed in a dust-proof case. The general view of the Mueller radial, Fig. 48, below, does not show the new speed-box applied. The principle upon which the variable-speed mechanism operates is made clear in the drawing reproduced at the right, Fig 45.

The driving shaft for this mechanism is shaft, A, and the delivery shaft, driving the drill is shaft, C, shaft, B, being an intermediate. Upon shaft, A, are mounted loosely the four gears, E, F, G and H, upon each of which gears is mounted a friction clutch for driving from the shaft. These loose gears mesh with gears, I, J, K and L, respectively, which are all keyed upon shaft, B, so that whenever a gear on shaft, A, is thrown in clutch, shaft, B, is driven at a different speed; this provides four speeds. Then, as may be seen from the end view, the drive is made from shaft, B to C, either through gears, K-N, or through gear train, L-P-Q-M, according as friction clutch, U, is thrown to the left or the right. This makes eight speeds available in the speed-box.

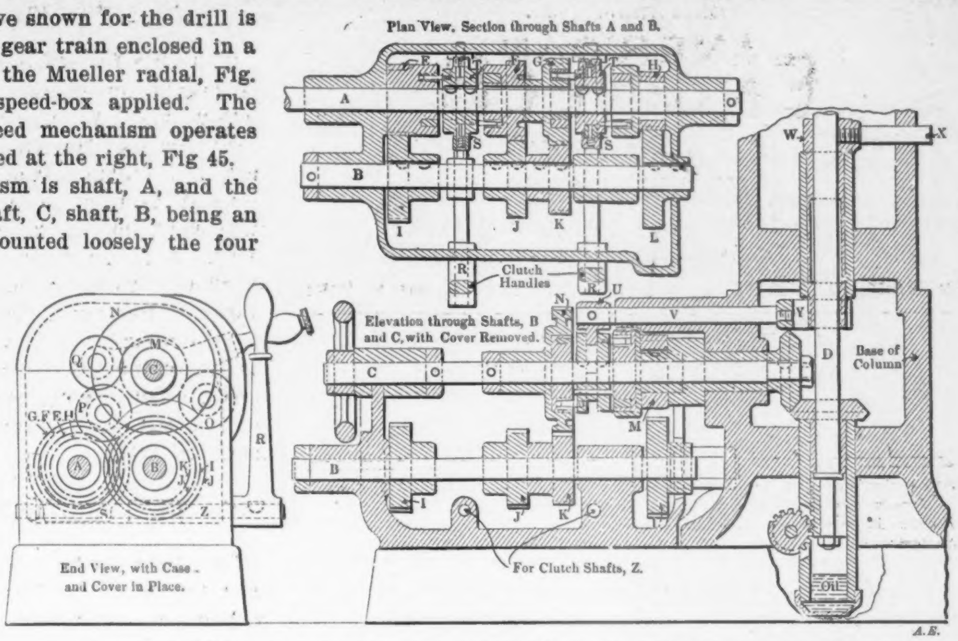


FIG. 45.—DETAILS OF THE VARIABLE-SPEED MECHANISM FOR THE MUELLER RADIAL DRILL.

The friction clutches controlling the four gears on shaft, A, are operated by the two lever handles, R, outside, which shift the wedges, T-T, by means of trunnions, S. These clutches are of the spring ring type, insuring smoothness of action in starting. The small lever shown on the front of the box is for the purpose of locking either one of the levers, R, while the other is in use, this being to prevent the accidental throwing of two gears in clutch on shaft, A, at the same time. The numbers, 1, 2, 3 and 4, on the case indicate the positions to which the levers, R, must be thrown for the various speeds available thereby, 1 being the fastest and 4 the slowest speed of that group.

Friction clutch, U, which governs the two speed ranges, is also used for starting and stopping the drill spindle. It is controlled from outside by a starting lever extending from the loose ring shown encircling the column above the swinging table, which ring engages with rod, X, shown in the drawing. As this ring is turned, sleeve, W, is turned and by a pinion at its lower end moves rack, Y, and, with it, rod, V. Thus, as the ring is thrown to the right or left, either the slow or fast train of gears is clutched to shaft, C, by U.

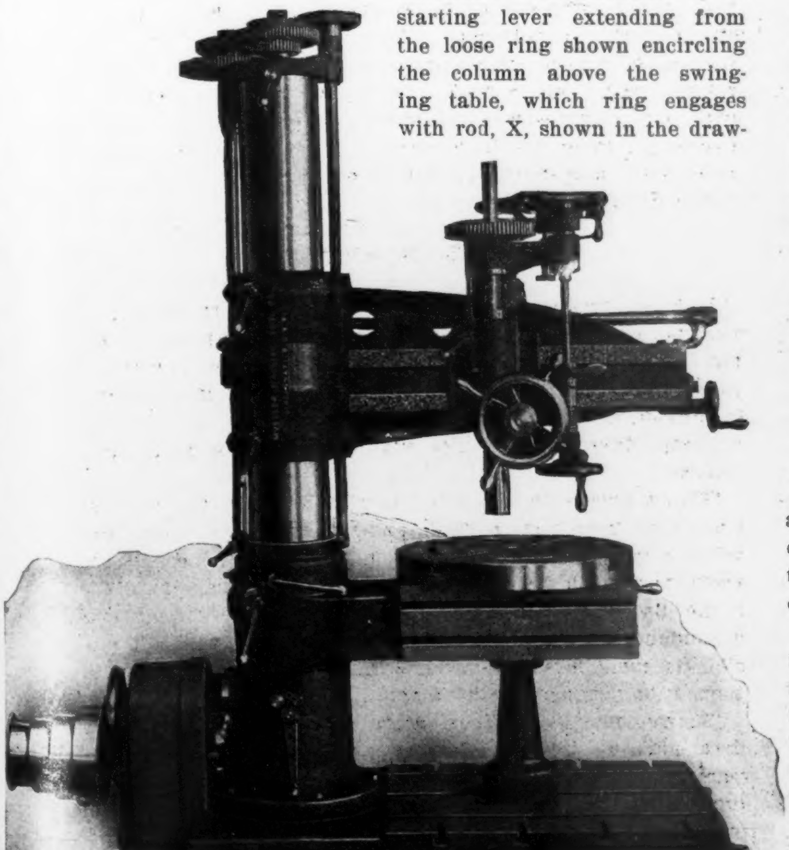


FIG. 48.—GENERAL VIEW OF THE MUELLER RADIAL DRILL.

Another feature of this portion of the mechanism is that of a double-throw train of gears between gears, L and M, by means of which a reversal of motion is permitted. These gears are carried on a tumbler as is made clear in the end view. Normally the drive is through L-P-Q-M, but by shifting the tumbler handle, gears P-Q are lifted up and gear, O, dropped into mesh with L, making the drive through L-O-M. This is a very convenient method of reversal for use in tapping, etc.

The starting lever is also used to control the power raising

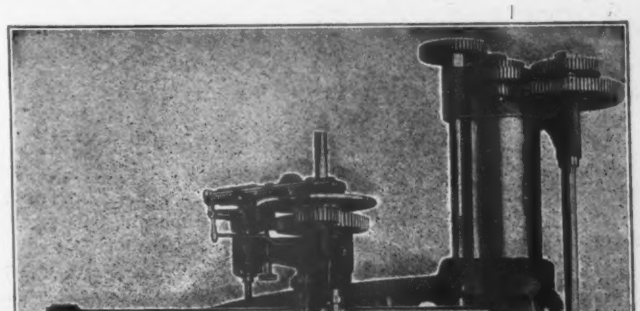


FIG. 47.—REAR VIEW OF HEAD UPON ARM, SHOWING DETAILS.

and lowering of the arm, as well as the stopping and starting of any of the entire range of speeds. When this clutch is thrown out the lower driving shafts, A and B, are the only ones in motion, thus reducing to a minimum the wear.

The variable-speed feeding device used upon the Mueller radial is a friction plate and disc, the location of which is made plain in Figs. 46 and 47. The friction disc is easily moved across the plate for changes of feeding speed, which may be made when the drill spindle is in operation. By moving the disc from the center to the rim of the plate, feeds from 0 to .023 in. per revolution of the spindle may be obtained. The drive for the automatic feed is made through a jaw clutch on the shaft carrying the worm which drives the gear on the feed shaft.

(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
J. S. BONSALL, Business Manager.
140 NASSAU STREET .... NEW YORK

G. M. BASFORD, Editor.
C. W. OBERT, Associate Editor.

SEPTEMBER, 1903.

Subscription.—*$2.00 a year for the United States and Canada;* **$2.50** *a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post Office Order.
Subscriptions for this paper will be received and copies kept for sale by the
Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburg, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

CONTENTS.

AN ADVANCE STEP IN SUPERHEATING.

If superheated steam can be used successfully in locomotives its introduction appears to be the most important improvement now at hand. An experimental application has given excellent results on the Canadian Pacific Railway for about two years, and Mr. Williams expresses his opinion of the idea in the practical form of two new locomotives which are to be fitted with superheaters. One of these is building at the Schenectady Works of the American Locomotive Company and the other in Scotland. These embody new construction, which is illustrated in this issue. This plan seems likely to prove entirely successful, and if so it will mark a distinct step in advance in the use of superheated steam. Mr. Williams is entitled to the credit of introducing superheating to the locomotive practice of this continent. Readers are urged to watch this development carefully.

THE NEW MULTIPLE UNIT ELECTRIC LOCOMOTIVE.

The design of the new electric locomotive that is soon to go in service upon the Belt Line Tunnel section of the Baltimore & Ohio, and which is illustrated on another page of this issue, is remarkable for being the first application of the multiple unit idea to heavy electric haulage. There are many advantages of this method over that of placing all the power and weight in one unit: the weight is distributed more evenly over the track, the individual units are smaller and less cumbersome, and, the most important of all, the locomotive may be increased in size indefinitely by the mere addition of more units to the group—in this way all the advantages of double-heading are obtained without the disadvantages. The multiple unit system permits any number of units to be grouped together and all operated and controlled simultaneously from one point on the train. This is an important move in the problem of simplification of the movement of heavy trains and will be watched with interest.

The design of each unit seems also to be entirely rational and practical. It is absolutely unhampered by the limiting conditions of steam locomotive practice, having been designed from a knowledge of and experience with the best electric railway practice of to-day. Cast steel frames of massive design were chosen, which furnish, besides great strength, the required weight for adhesion. Liberal provision has been made for ease of making necessary repairs, and inspection of the motors, trucks, etc., is made easy by the under-floor construction. The design seems altogether very commendable and the results in service will be of great interest in view of the proposed electrification of the New York terminals of the New York Central and Pennsylvania systems.

PROGRESS IN GRINDING.

Mr. C. H. Norton, authority on the subject of grinding, as a machine operation, presented an interesting statement of the state of the art in a discussion before the Master Mechanics' Association. His remarks are given below. We take pleasure in presenting them because of an error which occurred in reporting them in connection with the discussion at the convention:

"The improvements in grinding wheels within the last two years have been very marked, and what three years ago was called a good grinding wheel would not now be considered worth very much for cylindrical grinding. Perhaps it is due to the discovery of different abrasives and different methods of combining them together in wheels that has made it possible to make use of heavier grinding machines, and with them to do commercial grinding.

"As you may know, there are a number of artificial abrasives made at this time that were not known three or four years ago. For instance, artificial corundum, known as Alundum, is now made at Niagara Falls that has the same chemical properties as nature's corundum. That is, microscopic crystals of the ruby and sapphire are chemically the same as the

jewels. It seems a little funny to think of rubies and sapphires being made by the carload, but this is true. They are shipped to Worcester, where they are crushed into grains, and when their treatment is complete we have practically the pure crystals.

"The grinding machine of to-day is a very heavy machine, with plenty of pig iron in it, and very heavy steel spindles. Where four years ago a grinding machine that carried a wheel 12 ins. or 14 ins. in diameter had a spindle weighing perhaps 30 lbs. by itself, to-day a machine for doing the same work has a spindle weighing 100 lbs., a wheel 24 ins. in diameter, 2, 3 and 4 ins. thick, according to the nature of the work to be done.

"We are grinding piston rods to-day with wheels 4 ins. thick and advance along the work 4 ins. to every revolution of the rod during the roughing operation.

"Some idea of the size to which grinding machines are carried to-day may be had when I tell you that we are shipping at this time some grinding machines that are 22 ft. long and weigh some 22,000 lbs. each, and they are to grind work weighing up to 6,000 lbs. revolving on the centers of the machine.

"Briefly, the idea of the grinding machine to-day is to put more money and material into the machine, also more power into the shortest space of time to save labor."

MASTER MECHANICS' ASSOCIATION SCHOLARSHIPS.

A vacancy in the scholarship at Stevens' Institute of Technology at Hoboken should be filled immediately. The entrance examinations will be held September 14 to 17, inclusive. Anyone in the employ of members of the association is eligible and may apply to Mr. J. W. Taylor, secretary of the association, 667 The Rookery, Chicago, Ill., for further information. The J. T. Ryerson scholarship, presented at the recent convention, will be confined to Purdue University, the examinations being held September 7. This scholarship also is available to anyone in the employ of members of the association. Certificates and other information may be had from Mr. J. W. Taylor at the address already given.

The Grafstrom memorial fund is progressing and a generous response is assured from all who knew Mr. Grafstrom and those who did not, but who admire his character as shown in his self-sacrificing death. The executive committee of the Railway Supply Men, acting with the consent of the executive committee of the Master Mechanics' Association, has issued a statement of the object and plan. A quick and generous response is assured.

A new engineering association, called the American Railway Mechanical and Electrical Association, has recently been formed by the mechanical officials of electric railways. It is closely related to in object and will meet with the American Street Railway Association at Saratoga next week.

COMMUNICATIONS.

MEETING PLACE FOR CONVENTION OF 1904.

To the Editor:

I notice in your issue of August your remarks in regard to the next meeting of the Master Mechanics' Association to be held at St. Louis. You probably know that St. Louis has been mentioned before in connection with this matter, but was not considered favorably by the members of the association. One convention has been held there, which I attended, and, with many other old members, determined that I would never agree to another meeting in that city. The hotel accommodations were guaranteed, as they are now, and were found to be very unsatisfactory. The feeling toward the members of the convention was anything but genial. The citizens all seemed to be suffering from a severe frost. I earnestly hope that all the members who were with me at that time will aid in a vigorous protest against holding the convention in that city.

JAMES M. BOON.

Chicago, August 7, 1903.

PERSONALS.

Mr. S. B. Wight has been appointed purchasing agent of the Michigan Central to succeed Mr. James R. Dutton, resigned.

Mr. A. Harrity has been appointed master mechanic of the Atchison, Topeka & Santa Fe, at Raton, New Mexico, to succeed Mr. D. A. Sullier, resigned.

Mr. A. L. Humphrey has resigned as superintendent of motive power of the Chicago & Alton to become manager of the Westinghouse Air Brake Company's interests in Chicago.

Mr. G. A. Bruce has been transferred from the position of master mechanic of the Willmar & Sioux Falls division of the Great Northern to a similar position on the Superior & Mesabi division at Superior, Wis.

Mr. A. G. Elvin has resigned as master mechanic of the Delaware, Lackawanna & Western to become manager of the mechanical department of the Coffin-Megeath Supply Company, with headquarters at Franklin, Pa.

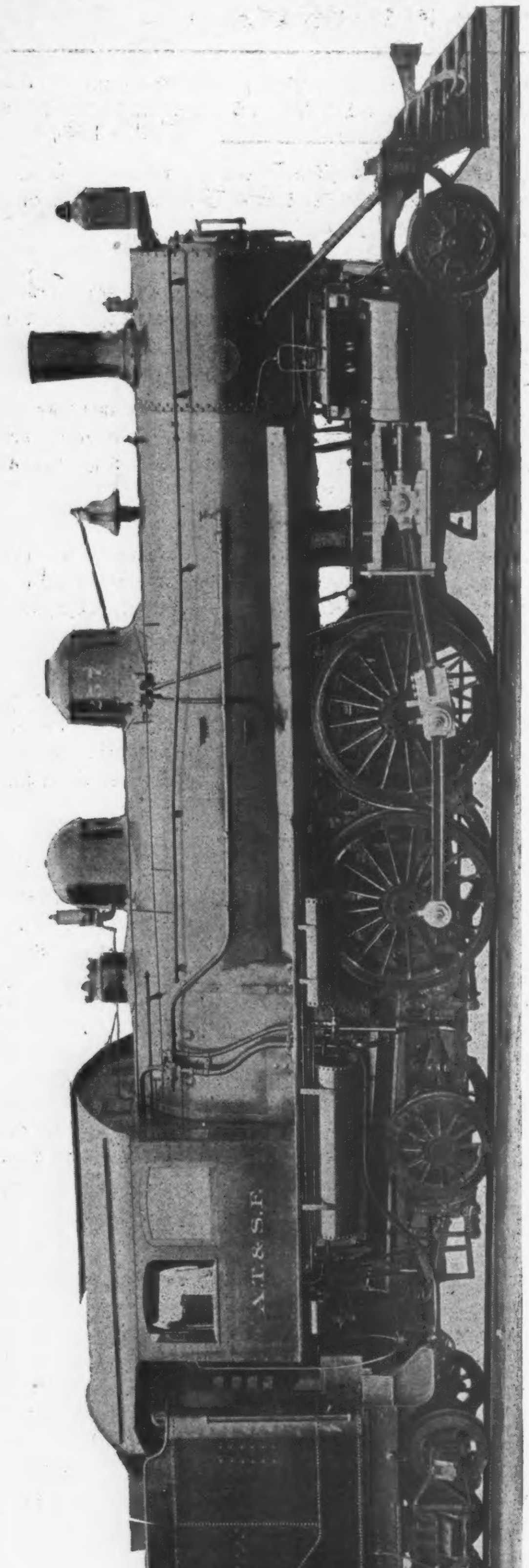
Mr. D. M. Perrine has been transferred from the position of master mechanic of the Pennsylvania at Pittsburgh to the same position at Philadelphia, and is succeeded at Pittsburgh by Mr. I. B. Thomas, promoted from the position of assistant engineer of motive power at Altoona.

Mr. R. F. Kilpatrick has been transferred from Kingsland, N. J., to Scranton, Pa., as master mechanic of the Delaware, Lackawanna & Western, to succeed Mr. A. G. Elvin, who recently resigned to enter the service of the Coffin-Megeath Supply Company. Mr. Kilpatrick is succeeded at Kingsland by Mr. W. L. Boler.

Mr. A. L. Moler has been appointed superintendent of motive power of the Chicago, Cincinnati & Louisville, with headquarters at Richmond, Ind. He has been master mechanic of the Vicksburg, Shreveport & Pacific, and is succeeded in that position by Mr. L. B. Ferguson, chief draughtsman of the New Orleans & Northeastern at Meridian, Miss.

Mr. D. F. Crawford has been appointed general superintendent of motive power of the Pennsylvania lines west of Pittsburgh, with headquarters at Pittsburgh. He is succeeded as superintendent of motive power of the Northwest System by Mr. T. W. Demarest, with headquarters at Fort Wayne, Ind. Mr. M. Dunn succeeds Mr. Demarest as superintendent of motive power of the Southwest System at Columbus. Mr. S. W. Miller succeeds Mr. Dunn as master mechanic of the shops at Columbus, and Mr. G. C. Bishop succeeds Mr. Miller as master mechanic at Logansport, Ind.

Mr. Theodore H. Curtis has been appointed superintendent of machinery of the Louisville & Nashville to succeed the late Pulaski Leeds. Mr. Curtis has been connected with this road as mechanical engineer since January 1, 1901. His railroad service began with the position of chief draughtsman of the Cleveland, Cincinnati, Chicago & St. Louis in 1886. After two years service with the Brooks and the Pittsburgh locomotive works he went to the "Nickel Plate" as chief draughtsman, and in 1899 was appointed mechanical engineer of the Erie, which position he held until he went to the Louisville & Nashville. Mr. Curtis is 37 years of age, and his appointment adds another to the list of young technical men to be selected for important motive power responsibilities. Mr. Harry Swoyer, heretofore general master mechanic, has been appointed assistant superintendent of machinery.



Baldwin Locomotive Works, *Builders.*

VAUCLAIN FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

COMPOUND PASSENGER LOCOMOTIVES, 4—4—2 TYPE

Vauclain Four-Cylinder Balanced System.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

The engraving presented at the left represents one of the four balanced compound locomotives that the Baldwin Locomotive Works have recently built for the Santa Fe. The details of these locomotives were illustrated and described very fully on pages 210-213 of our June (1903) issue, but a photograph of the locomotive was not available at that time.

These locomotives are of the 4—4—2, or Atlantic, type, but present a marked difference in external appearance, in that the main drivers are located ahead instead of at the rear, as is usual with unbalanced locomotives of this type. This construction is, of course, essential in the four-cylinder balanced compound to admit of the necessary inside rod connections between the high-pressure cylinders and the cranked main axle. Otherwise the locomotive does not differ in appearance noticeably from the ordinary 4—4—2 type engine. The results to be met in service with these engines will be eagerly watched for by all locomotive officials.

NEW LOCOMOTIVE AND CAR SHOPS.

COLLINWOOD, OHIO.

Lake Shore & Michigan Southern Railway.

X.

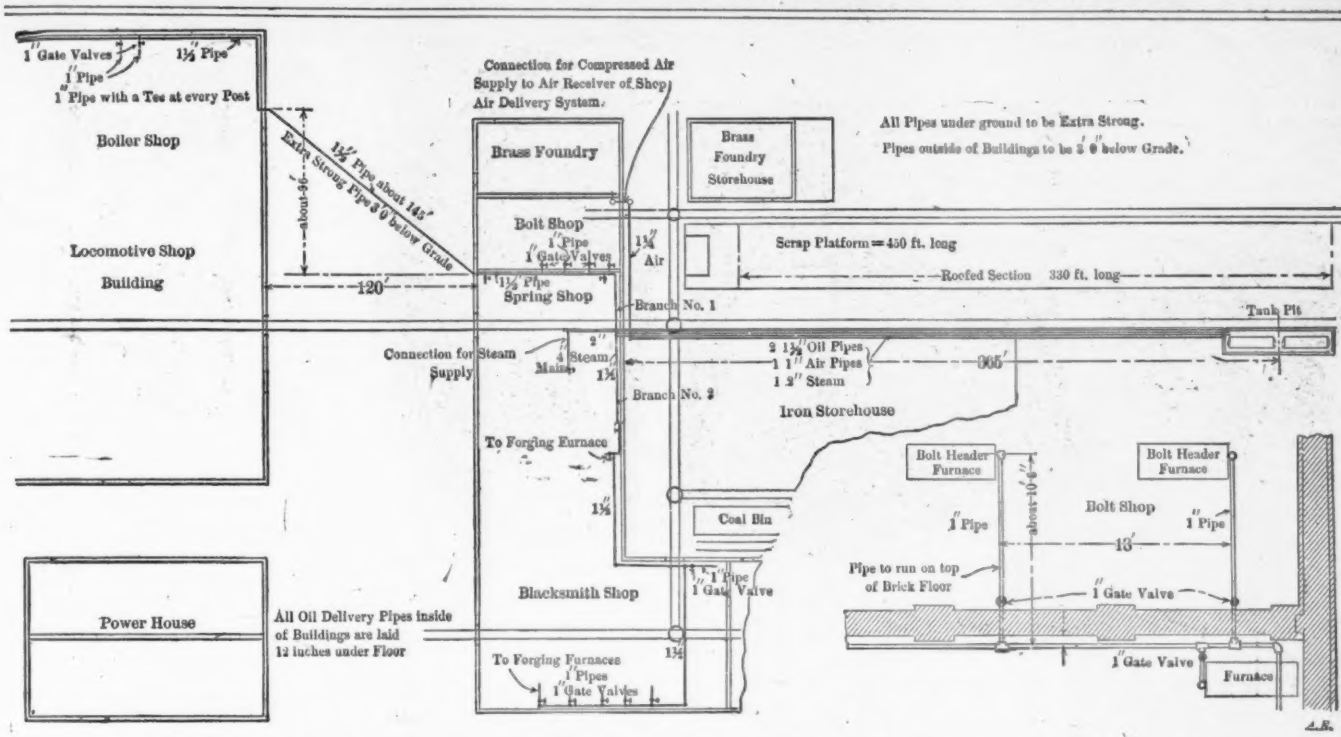
THE FUEL OIL STORAGE AND DELIVERY SYSTEM.—THE OIL FURNACES.

In the design of the auxiliary equipment for the Collinwood shops of the Lake Shore & Michigan Southern Railway particular attention was given to the arrangement of the piping and storage system for handling the fuel oil for use in the oil furnaces, as well as also to the selection of the oil furnaces for the peculiar service to be met. For a large number of the heating furnaces, as well as annealing and case-hardening furnaces, it was decided to use crude petroleum for fuel. Twenty-one oil furnaces have been placed in the boiler and blacksmith shops, which necessitated the installation of an extensive fuel supply system. The storage system adopted was that of underground storage tanks located apart from the shop buildings, from which the oil is delivered to the various furnaces by air pressure in the tanks.

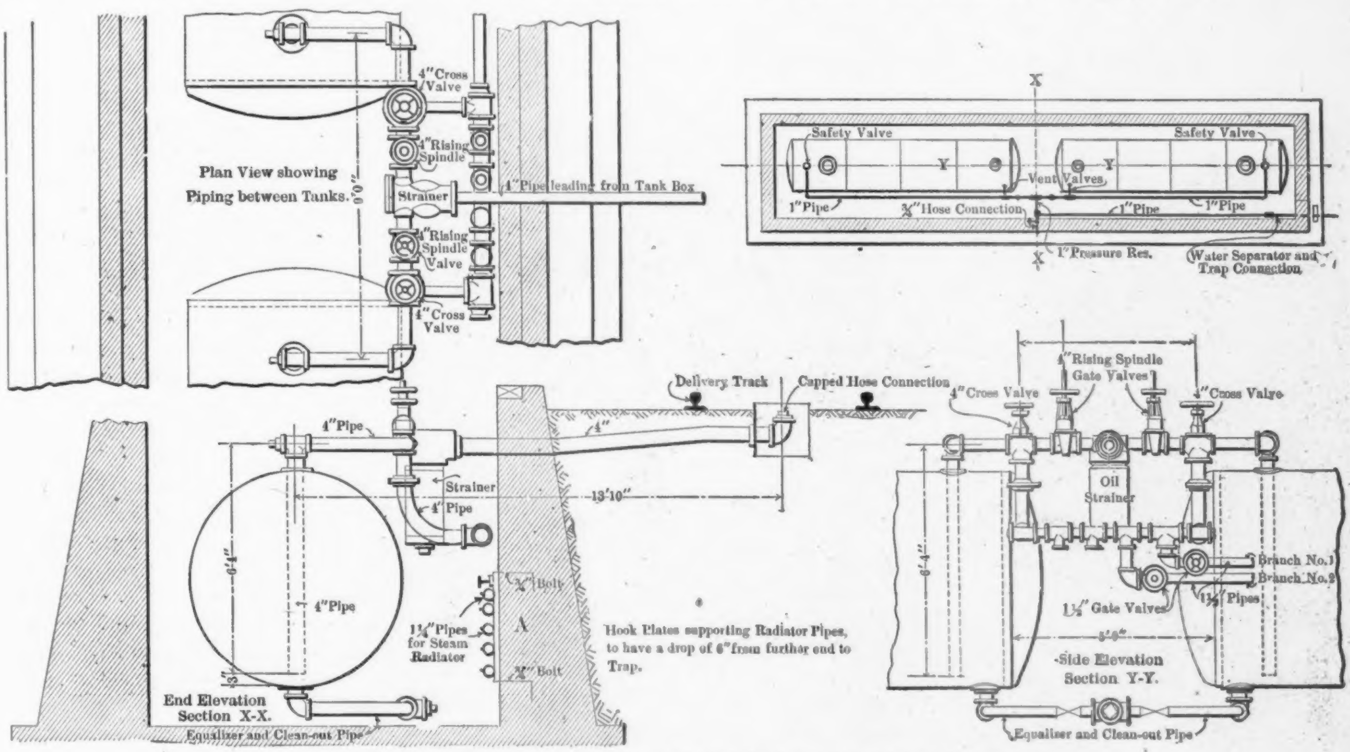
An engraving on page 335 presents a general plan of the storage tank arrangement and of the delivery piping system. The two storage tanks are situated in a depressed concrete pit, near the east end of the scrap platform, 365 ft. from the east wall of the spring shop. From this point two oil pipes run west into the blacksmith shop, where one branch (No. 2) runs south to supply the forging and case-hardening furnaces in that department, while the other (No. 1) runs north to the spring and bolt shops and thence to the boiler shop. All the piping laid underground is extra strong pipe and is placed 3 ft. below grade, except inside of buildings, where it is laid 12 ins. below the floor level.

There are two storage tanks having a capacity of 12,000 gals. Their arrangement in the pit and also the arrangement of the piping connections for filling and delivery are shown in the lower drawing. The pit is situated alongside of a track to permit filling direct from the cars, a hose connection for use with the tank cars being arranged in the special track box shown in the engraving. In filling the oil passes through the 4-in. pipe from the track and through a large strainer, from which it can be delivered into either tank. By means of the valves and connections provided, one tank may still be kept delivering oil while the other is being filled.

The tank pit is arranged for steam heating in order to increase the fluidity of the oil, the location of the radiator being indicated in the end view of the pit. Steam is piped from



PLAN OF THE FUEL OIL DELIVERY-PIPE SYSTEM, SHOWING ALSO DETAILS OF FURNACE CONNECTIONS IN THE BOLT SHOP.



DETAILS OF PIPING CONNECTIONS TO STORAGE TANKS IN THE TANK PIT.

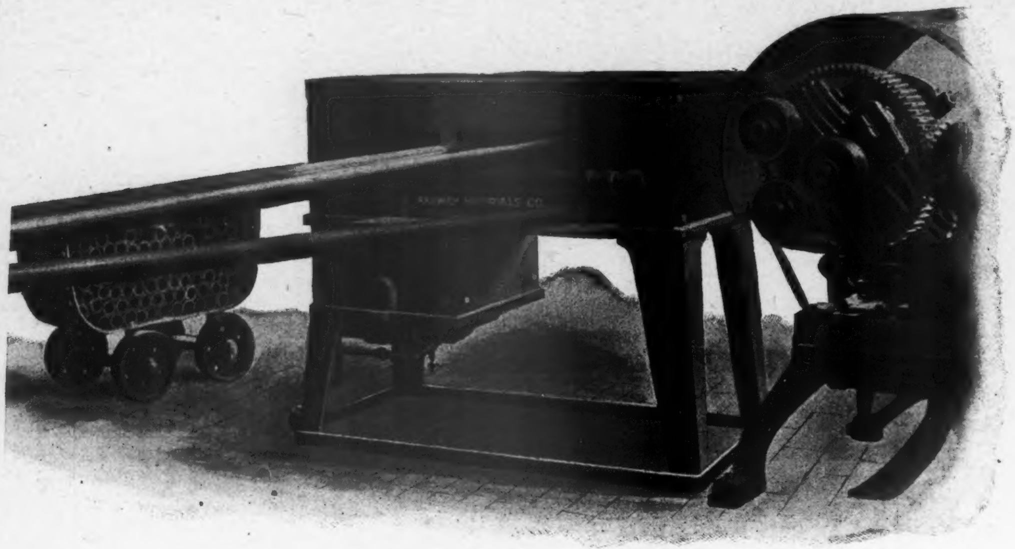
FUEL OIL STORAGE AND DELIVERY SYSTEM.

COLLINWOOD SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

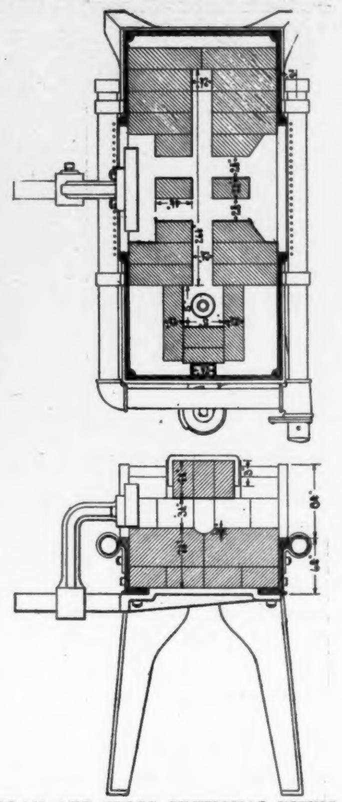
the large main supplying the steam hammers in the blacksmith shop and runs to the tank pit alongside of the oil delivery pipes, tending thus to keep the oil heated in delivery. A steam trap removes condensation from the radiator as it accumulates in heating.

The oil is forced to delivery by air pressure carried in the storage tanks. The compressed air supply is taken from one of the receivers in the shop air supply system, located in one corner of the bolt shop. The air pressure connections to the tanks are so arranged that either tank may be cut out and relieved for filling or cleaning and the other left on delivery. Either tank is safe under a pressure of 50 lbs. per square inch and each has a large pop safety valve for relieving an excess of pressure.

By means of this system of fuel supply no oil is stored at the furnaces, only the oil and air delivery pipes appearing above the floor near any of the furnaces. And furthermore each separate group of furnaces has an independent air supply, furnished by a motor-driven pressure-blower outfit, as the Ferguson furnaces which are used require a blast of about 8 ozs. pressure. There are seven blower outfits, distributed as follows: One each for the bulldozers, scrap forging, the spring shop, the bolt shop, the boiler shop, the flue and tin shop and the case-hardening furnace. The latter furnace is supplied exclusively by a single blower outfit, using a positive blower and a multiple-voltage motor so that it can be run all night at a low blast. The advantage of operating independent blower outfits lies in the fact that, while not only the cheapest and most convenient arrangement, it avoids running one large blower all the time at a low efficiency, unless all



VIEW OF THE FLUE WELDING FURNACE IN PLACE.
THE OIL FURNACES.—COLLINWOOD SHOPS.



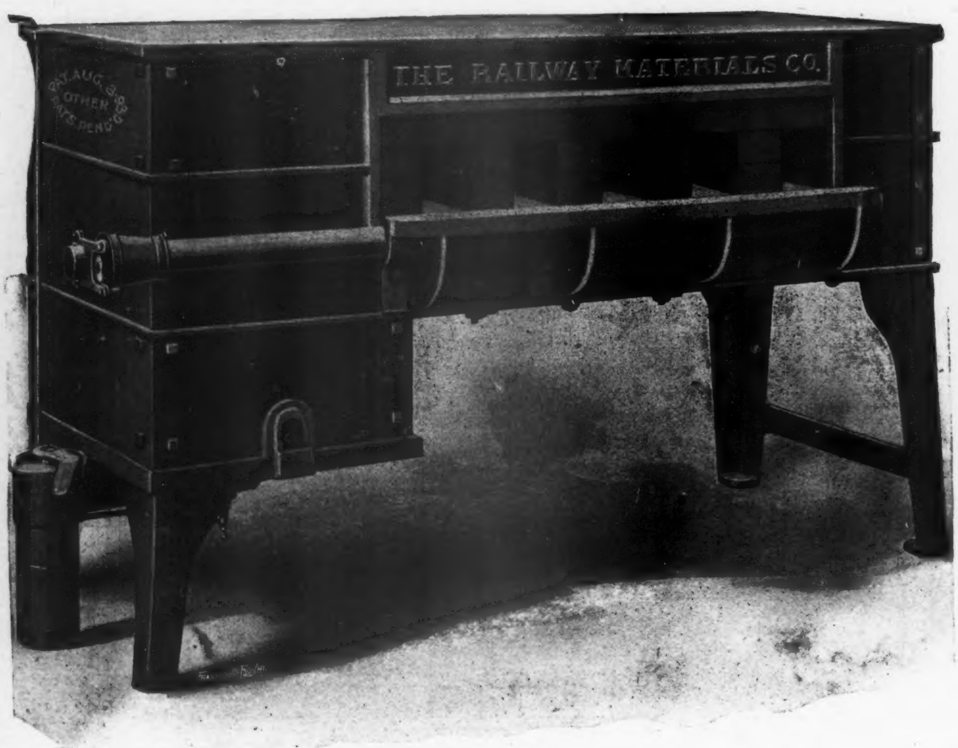
PLAN AND CROSS SECTIONAL VIEWS.

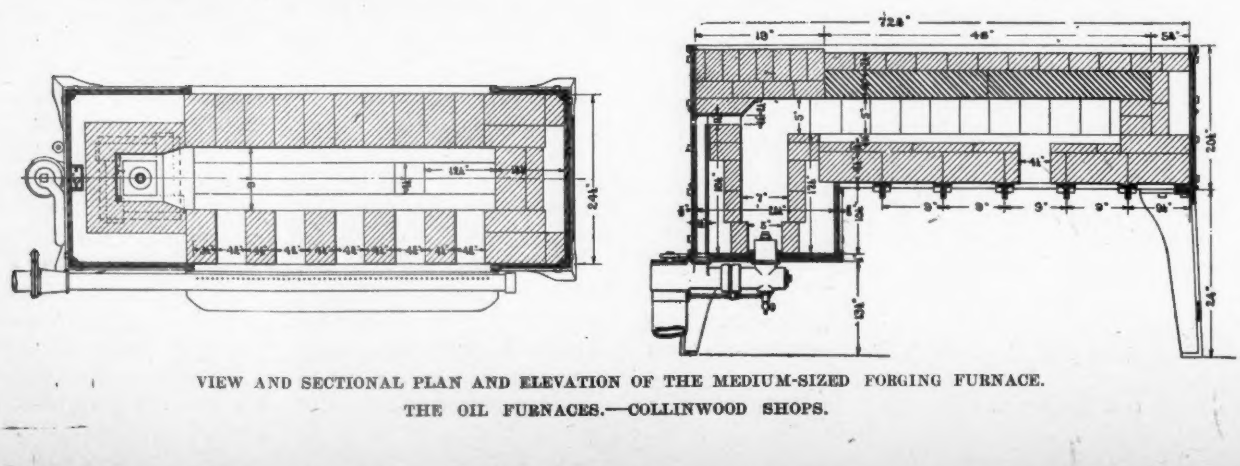
the furnaces are in use. Also it would have been very difficult to avoid large drops of pressure if a single blower and large delivery system had been used; as it was, great care had to be exercised in the designs of the various small blower systems to avoid reducing the velocities of flow of the blast by sharp elbows or abrupt turns.

Oil furnaces for flue and general blacksmith and boiler shop use offer many advantages over those using other fuel. When first introduced oil was so cheap as to cause the question of economical consumption to be overlooked; the result was a lot of home-made furnaces which, while operating satisfactorily, consume from 60 to 120 gals. of oil in doing work for which 30 to 35 gals. would be sufficient under correct furnace conditions. The time has come for the careful study of oil furnaces which has been given to this part of the equipment of the Collinwood shops, where a complete equipment of oil furnaces has been installed by the Railway Materials Company, of Chicago, under the personal direction of Mr. G. L. Bourne, of that company. These are the Ferguson furnaces, the theory of the burner of which was outlined on page 363 of the December number of this journal of last year.

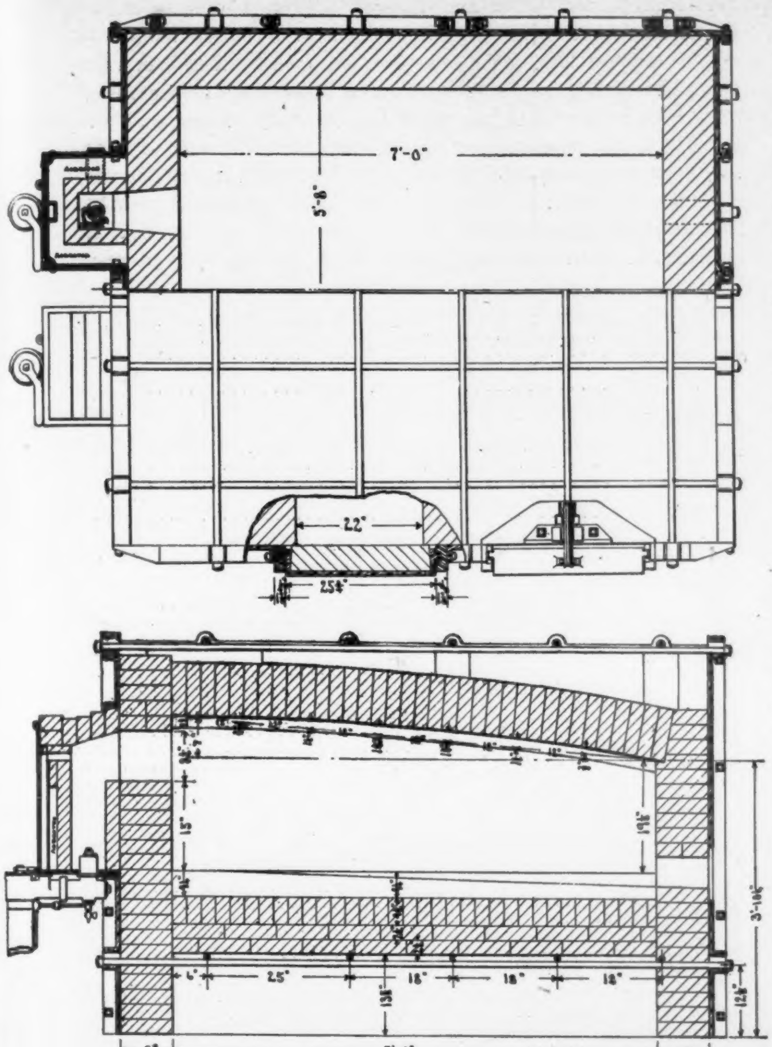
The list of this equipment at Collinwood is as follows:

Bolt shop:
5 Bolt furnaces.





VIEW AND SECTIONAL PLAN AND ELEVATION OF THE MEDIUM-SIZED FORGING FURNACE.
THE OIL FURNACES.—COLLINWOOD SHOPS.



PLAN AND SECTIONAL ELEVATION OF THE LARGE FORGING FURNACE.

Spring shop:
- 1 Fitting furnace.
- 1 Spring tapering furnace.
- 1 Banding furnace.

Blacksmith shop:
- 2 Forging furnaces (for heavy work).
- 2 Forging furnaces (for bulldozer work).
- 1 Large bolt furnace (for bolt header).

Boiler shop:
- 3 Flue furnaces.
- 1 Flanging furnace.
- 1 Rivet furnace.
- 1 Annealing furnace.

Tin shop:
- 1 Pipe furnace.
- 1 Pipe and brazing furnace.

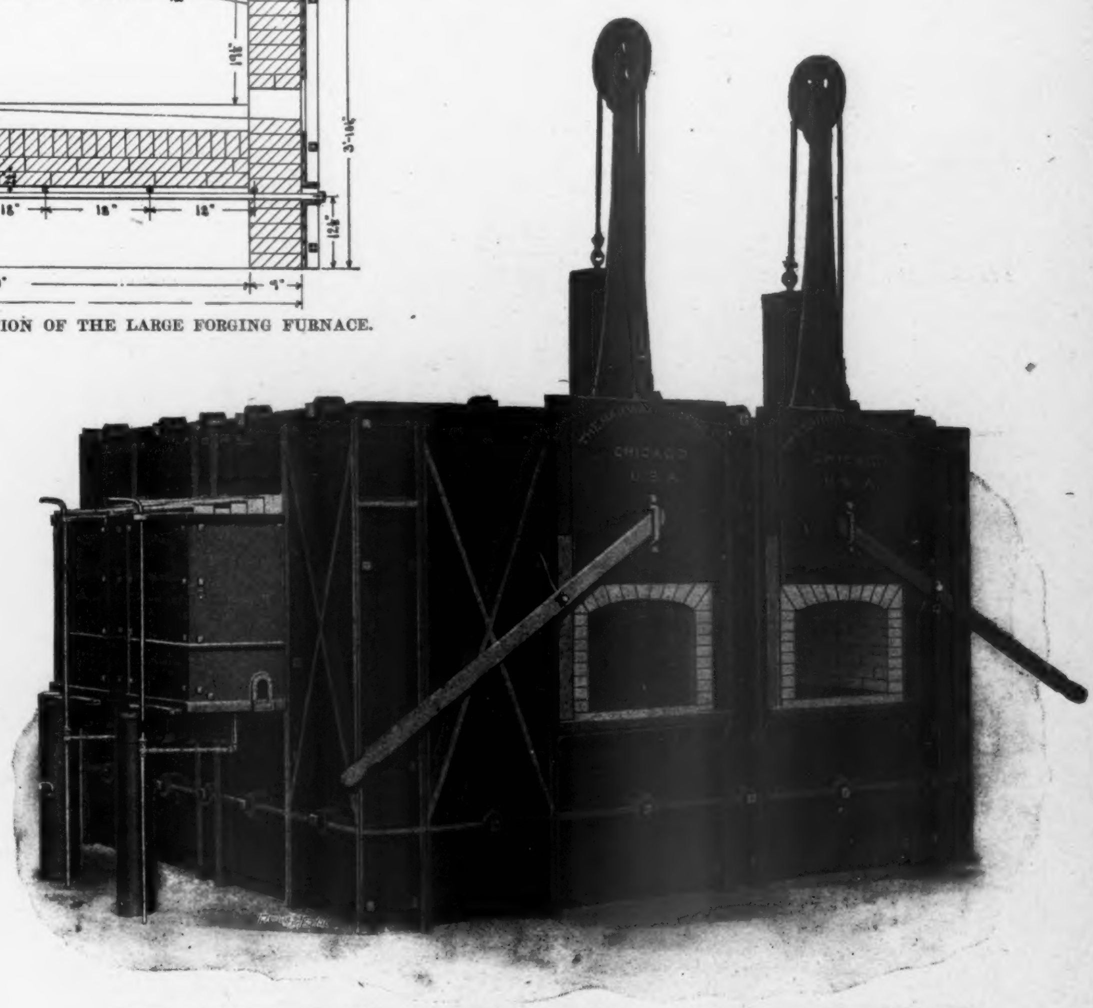
Total—21 furnaces.

This equipment is designed on the basis of heating all the material which the attendants can handle and the machines can use. In the case of the flue furnace, 60 flues per hour are heated to a welding heat all day long on a daily consumption of 25 gals. of oil. The bolt furnace heats the material fast enough to turn out 4,500 1-in. bolts per day on a consumption of 30 gals. of oil. Some of the large furnaces at Collinwood were specially designed for the installation, and altogether this equipment is worthy of record as an example of excellent practice, not only in the furnaces, but their installation and in the oil storage and distribution system.

In large furnaces usual practice employs brick construction with heavy buckstays to hold the structure together, and usually the door casting completes the metal parts. If an oil furnace of this kind is changed to burn coal, very little of the original investment remains. The Ferguson built up furnaces are in two parts, the brick furnace, or the lining, and the outer casing of cast iron, which is independent of the lining and put up in panels for easy enlargement or conversion for coal burning.

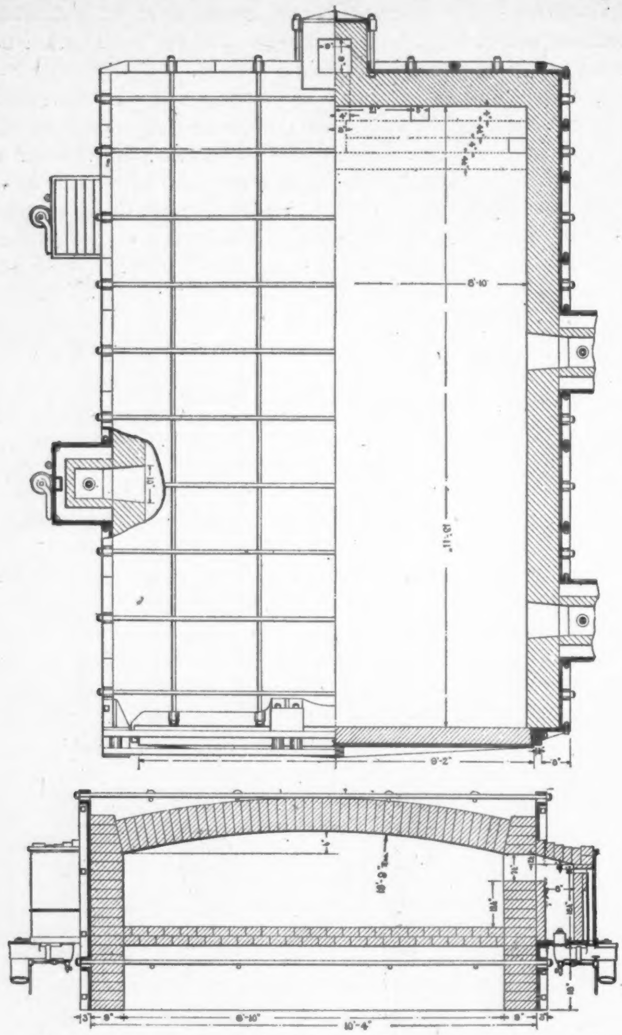
The flue welding furnace is illustrated on page 336. Its capacity is limited only by the ability of the attendant in handling the flues. The chief advantage offered by oil in this connection, in addition to the uniform and satisfactory high temperature, is the steadiness with which it is maintained and the saving of time lost in building and frequently cleaning a coke fire. Three of these furnaces are employed at Collinwood for flue welding, safe-ending and annealing.

Below, on page 336, the medium-sized forging furnace is illustrated. Two of these are used in the blacksmith shop, one for serving the heavy upsetting machine and the other for the Bradley hammer. One of them is bricked up to hold two crucibles for melting babbitt and the other is arranged to receive injector and other pipes for bending. They may be used from both sides or long material may be run directly through the furnaces. They are very efficient for either end or center heats.



THE LARGE FORGING FURNACE, SERVING THE HEAVY HAMMER IN THE SMITH SHOP.

Another design selected for illustration is the large forging furnace for serving the heavy hammer in the blacksmith shop. It is shown on this page. The object in this design was to secure the maximum heating space with the minimum floor space. No stacks or vents are provided, the whole heat being available for the material.



PLAN AND SECTIONAL ELEVATION OF THE ANNEALING AND FLANGING FURNACE.

The large annealing and flange furnace, which is shown in detail on this page, is located in the boiler shop and occupies about half the floor space required by a coal or coke furnace. This renders it possible to place the furnace favorably with reference to the work and the easy control and uniformity of the temperature undoubtedly contributes to satisfactory work and avoids the danger of flue bents and cracked sheets.

As a supplement to this description the following comparative figures are given on work by oil and coke furnaces with coke at $8.80 per ton and oil at the high price of 7.68 cents per gallon:

BOLT MACHINES.

Present furnaces use 700 lbs. of coke per day at $8.80 per ton...	$3.08
Heater per day	1.25
Machine man	1.70
Total	$6.03

Output per day per machine, 2,000 bolts; or a cost of 1,000 bolts, $3.01½.

With oil furnaces 30 U. S. gals. of oil per day used at 7.68 cents..	$2.30
Heater per day	1.25
Machine man	1.70
Total	$5.25

Output 4,000 bolts per day or cost per 1,000 bolts, $1.31.

NUT MACHINES.

Present furnaces use 1,200 lbs. coke per day at $8.80 per ton....	$5.28
Heater per day	1.30
Machine man	1.70
Total	$8.28

Output per day 2,000 lbs. nuts; cost per 1,000 lbs. of nuts, $4.14.

With oil furnace 50 U. S. gals. of oil to be consumed at 7.68 cents per gal.	$3.94
Heater per day	1.30
Machine man	1.70
Total	$6.94

Output per day 3,000 lbs. or cost per 1,000 lbs. nuts, $2.31.

FLUE WELDER.

Present furnaces use 400 lbs. coke at $8.80 per ton	$1.70
Heater per day	1.30
Machine man	1.50
Total	$4.56

Output per day 100 flues or cost per 100 flues, $4.56.

An oil furnace uses 25 U. S. gals. of oil at 7.68 cents	$1.92
Heater, same as above	2.80
Total	$4.72

Output per day, 600 flues, or cost per 100 flues not quite 80 cents.

SOAPSUDS IN AIR COMPRESSORS.

In discussing accidents to air compressors due to combustion within them, *Compressed Air*, referring to lubrication, says: "A drop of oil every five minutes is sufficient in an air compressor cylinder of ordinary size, and every engineer should feed soapsuds into his cylinders for at least one day in the week, in order to wash away any deposit which may have accumulated through the use of oil which has been acted on by high temperatures in the air. These soapsuds may be fed through the regular oil cup. Care should be taken, however, not to let the machine lie idle with soapsuds remaining in it—that is, shortly before quitting time the feeding of soapsuds should be stopped and oil feeding substituted." This is of importance, particularly with high pressures. It will also assist in reducing wear in cylinders.

THE LARGE ANNEALING AND FLANGING FURNACE IN THE BOILER SHOP.

THE OIL FURNACES.—COLLINWOOD SHOPS.

THE SHEEDY CIRCULATING PIPE FOR LOCOMOTIVE CYLINDERS.

This device has been in use nearly two years on the Southern Pacific with satisfactory results. Its purpose will be understood through a description of its operation. When the throttle is open, steam enters the small pipe in the branch pipe at A, Fig. 2, passes through the connecting pipes and seats the valve C by means of the piston in the cylinder B. When the throttle is closed the check valve C closes and the pressure in B leaks off through a small hole in the check valve. The valves C are opened by the springs in the cylinder B and the circulating pipe is open from one end of the cylinder to the other. The action is automatic and the effect is the same as that produced by the "floating" of an ordinary slide valve when an engine is drifting. The relief valves D provide means of escape of water in the cylinders which may destroy the cylinders, break the crosshead, or bend the piston rod, of a piston valve engine. Fig. 3, on the following page, illustrates an improved arrangement of the valves.

The compression of air when drifting is greater in an engine with piston valves than in one with plain valves because of the smaller clearance spaces and the inability of the valves to lift. The compression is often a serious matter, not only because of the shocks to the machinery, but because of causing flat spots in the tires. Indicator cards do not give a measure of the shocks because much of the energy of compression is absorbed in retarding the reciprocating parts, and it is only by combining the inertia effect at the different points of the stroke with the cylinder pressure at those points that the true action of the compression can be obtained. If an indicator is used on a piston valve engine drifting at 40 or 45 miles an hour the compression will make it "pound" so that it will not record positively. This indicates that something is going on in the cylinder in the way of sudden shocks.

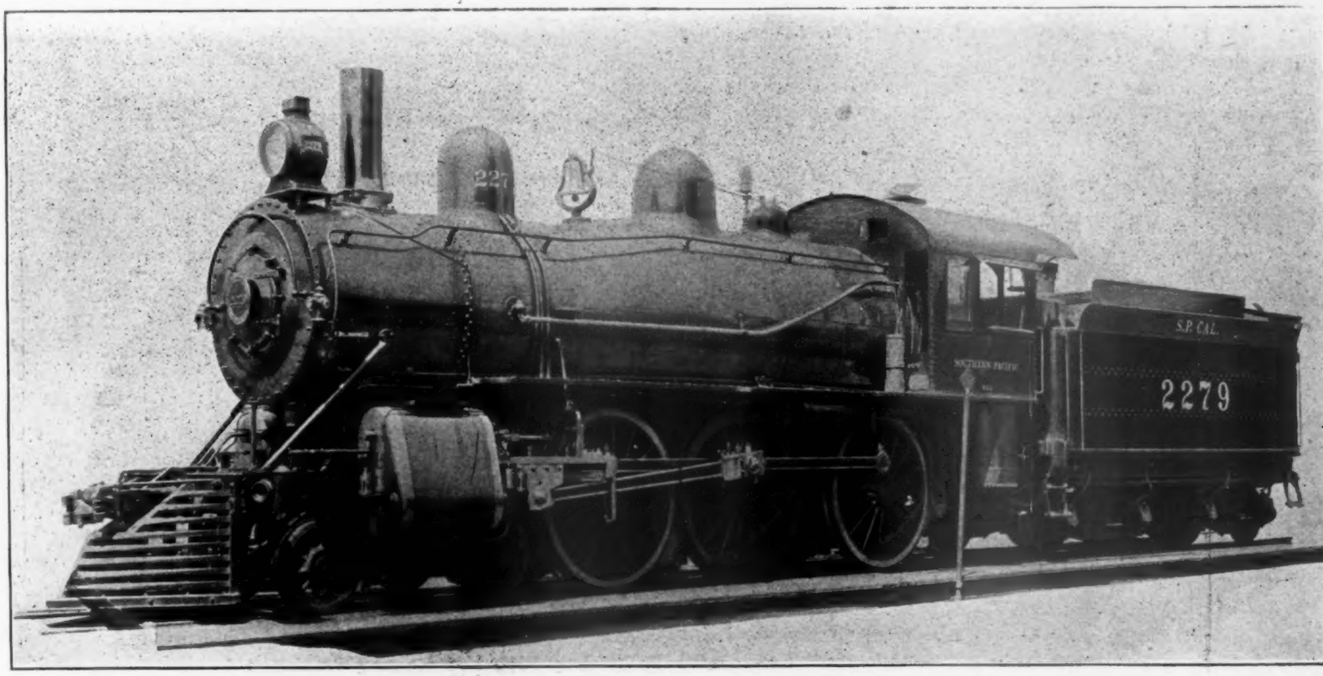


FIG. 1.—VIEW OF THE CIRCULATING PIPE APPLIED TO A SOUTHERN PACIFIC LOCOMOTIVE.

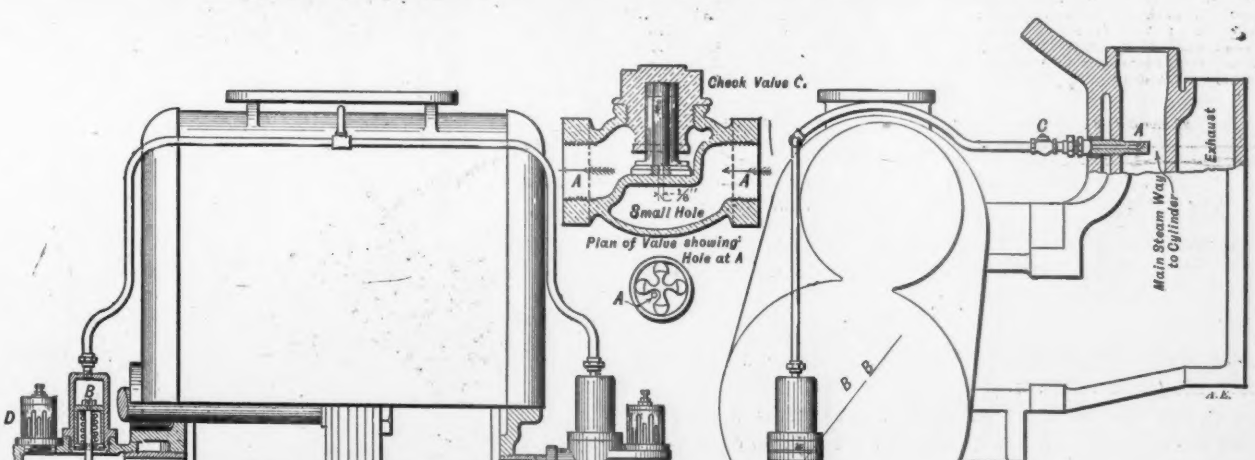
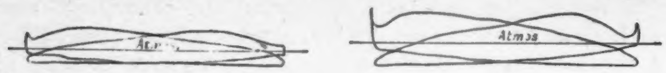


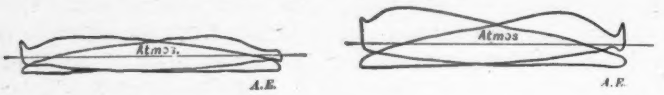
FIG. 2.—SECTION SHOWING ATTACHMENT TO CYLINDER.

The indicator cards of Fig. 4 from the low pressure cylinder of engine No. 2918 illustrate the effect of the Sheedy circulating pipe. These cards were taken with and without the pipe in action and comparisons may be drawn at very nearly the same speeds. The mean of all the cards shows a relief by action of the circulating pipe of 29.4 per cent of the brake power of the pistons in descending grades. A notable condition in the Sheedy device is the absence of shock of compression at the end of the stroke and the braking effect is shown to be a steady resistance when the reverse lever is at full stroke. The advantage of the braking effect of the cylinders on



27	Speed, M. P. H.	28
6.0	Mean brake pressure	8.5
153.0	Total brake H. P. on piston	226.1

32.3 per cent. brake power relieved.



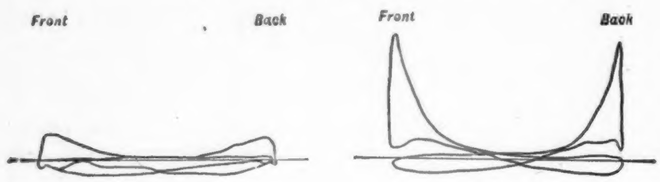
29	Speed, M. P. H.	29
6.6	Mean brake pressure	9.08
179.7	Total brake H. P. on piston	247.34

27.3 per cent. brake power relieved.

FIG. 4.

descending grades is acknowledged, but it should be given without shock to the engine.

The accompanying photograph, Fig. 1, shows the application of the device to one of a number of simple piston-valve engines upon this road. The indicator cards, Fig. 5, from this engine illustrate the effect of the circulator. This engine was taken into the shop for repairs after 18 months' service, and the piston valves were found to be in perfect order with no sign of wear. Fig. 2 shows the application of the low pressure



CARD NO. 1. CARD NO. 1½.

CARD NO. 6. CARD NO. 6½.

No. Card	1	1½	6	6½
Cut off—position of lever	10	10	22	22
Speed—M. P. H	41	41	40	42
Mean brake pressure on piston, lbs.	5.77	7.2	4.57	9.32
Total brake power—H. P.	100	126	80	170
Per cent. relieved by pipe	21	..	52	..
Terminal compression above atmosphere	10	60	2	15
Per cent. relieved by pipe	80	..	86	..

STEAM CHEST CARDS WITH PIPE CUT OUT—SHOWING PRESSURE IN STEAM CHEST WITH THESE CUT-OFFS.

FIG. 5.

cylinder of the compound engine No. 2474. Mr. Small sums up the advantages as follows:

The device is absolutely automatic, the valves are bound to close when the throttle is opened and are sure to open when it is closed. Its application to a simple engine brings the compression line just where it is wanted. In the case of engine No. 2279 it takes off 83 per cent at the point of terminal compression and leaves enough to steady the reciprocating parts when the engine is drifting at high speed. The circulator keeps the temperature of the air in the cylinders normal. It is not chilled, as in the case of valves opening to the atmosphere, and it is not heated hot enough to melt the rod packing rings and destroy the lubricating oil, which has occurred. This arrangement on either a single expansion engine or on the large cylinder of a compound engine prevents drawing gases through the exhaust nozzle to relieve vacuum, taking in cinders and destroying the lubrication and piston packing, and it also avoids the undesirable draft on the fire in drifting. With this draft the grates must be kept covered, even if the pops are blowing, in order to protect the firebox from injury. The problem of relieving cylinders from water

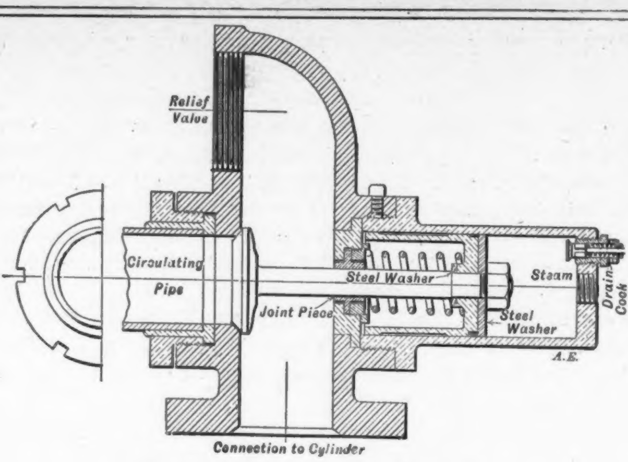


FIG. 3.—DETAILS OF RELIEF VALVE.

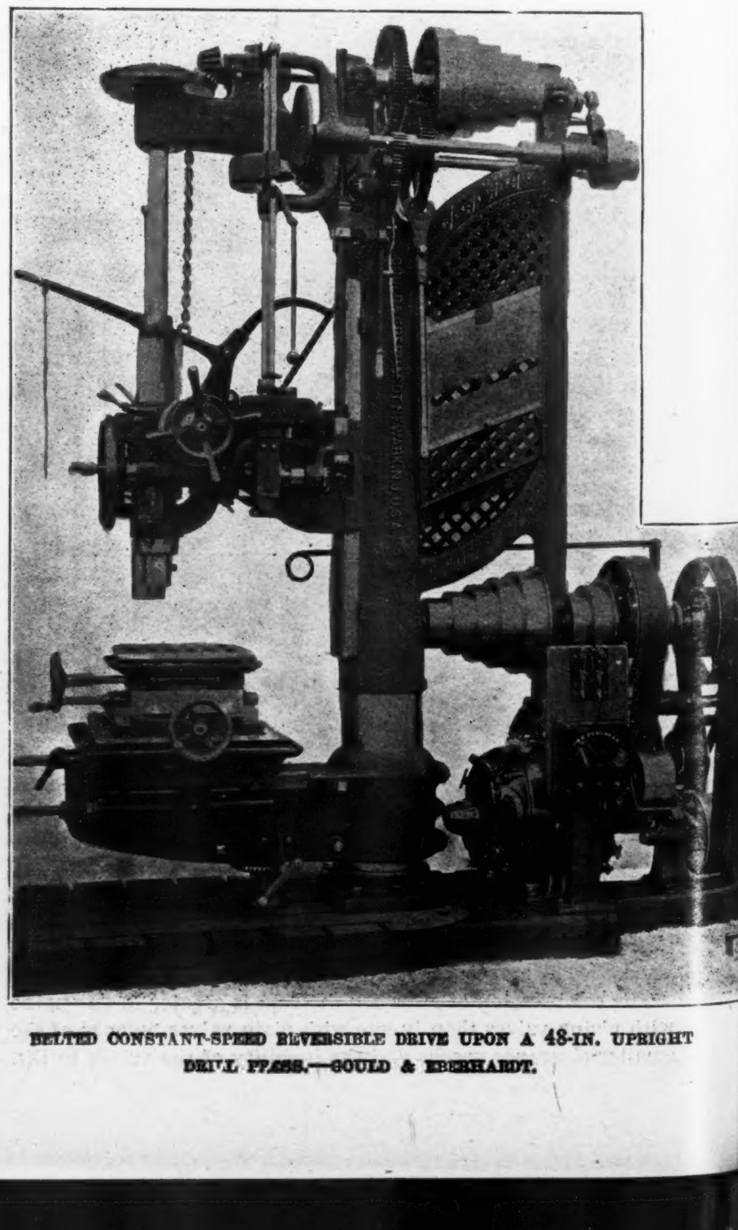
has given serious trouble on this road when the boilers are inclined to prime.

This device is protected by patent issued to Messrs. P. Sheedy and A. Campbell. The drawings and information were supplied by Mr. H. J. Small, general superintendent of motive power of the Southern Pacific Company.

MOTOR-DRIVEN MACHINE TOOLS.

Recent Practice in the Application of Electric Drives to Drilling Machinery.

Important developments have, of late, been made in methods of applying electric-driving to drilling machinery, as well as to other classes of machine tools. The importance of having available at all times at the drill the ready and ample power supply, inherent in the motor drive, to enable the greatest



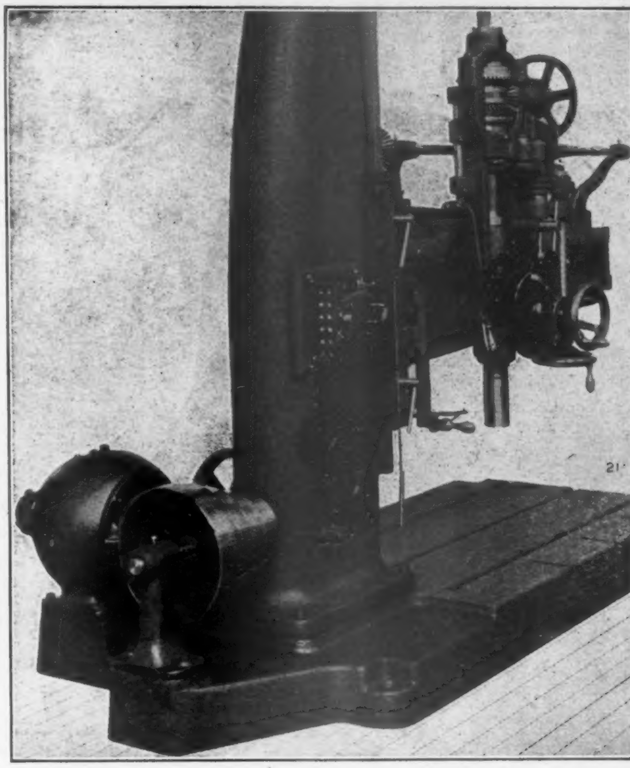
BELTED CONSTANT-SPEED REVERSIBLE DRIVE UPON A 48-IN. UPRIGHT DRILL PRESS.—GOULD & EBERHARDT.

capacity of the tool to be reached, is being comprehended by the users of machine tools as well as the builders. Electric driving has been a strong factor in rendering the greatly increased production possible with drilling machinery. We are permitted to present herewith illustrations of several representative methods of arranging motor-drives for this class of tools.

An interesting drive is presented in the engraving on page 340, which illustrates the 48-in. patent-upright drill press, with a constant-speed electric drive, which Gould & Eberhardt, Newark, N. J., recently furnished to the Norfolk Navy Yard. This tool is in itself very complete and general in its adaptability to all classes of work, having a special oblong, compound-traverse tapping table and portable compound chuck, and also an automatic tapping attachment. It is fitted with the many improvements, including automatic friction feeds and time-saving refinements, that characterize the Gould & Eberhardt drills, and also has a back brace.

The important feature of this tool is arrangement of the drive. The motor, which is an enclosed constant-speed, direct-current machine, is located under the forked brace, on an extension of the base, with the main switch and starting box located conveniently near. It drives the small countershaft above it either through a direct belt for forward motion, or through a geared pulley and direct belt for reverse motion, as is clearly shown in the engraving. Both of these belts operate with the motor, either one being thrown in action at will by the friction clutch having a handle extending out over the table. This arrangement is very commendable, as it obviates the necessity of using crossed-belts, with their attendant disadvantages, for the reverse motion. It is a very convenient method of driving with a constant-speed motor also, as the friction-clutch drive enables the drill spindle to be started and stopped instantly without waiting for the motor to come to rest.

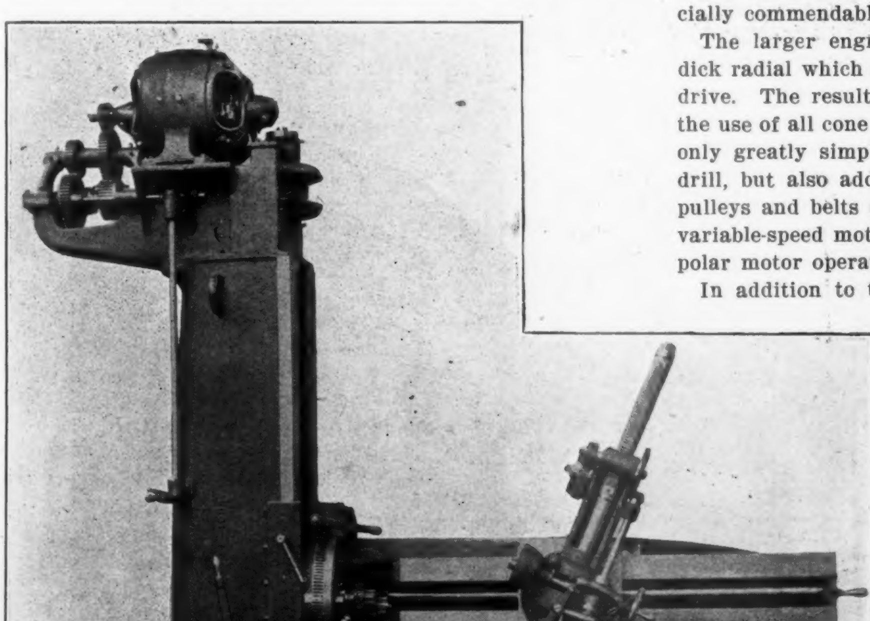
The two engravings presented upon this page illustrate the methods of mounting both variable-speed and constant-speed drives, which have successfully been made use of by the Fosdick Machine Tool Company, Cincinnati, Ohio. These examples will take their place as the best practice in motor applications to this class of tools, the variable-speed drive being especially commendable.



CONSTANT-SPEED DRIVE UPON A DRILL PRESS.—FOSDICK MACHINE TOOL COMPANY.

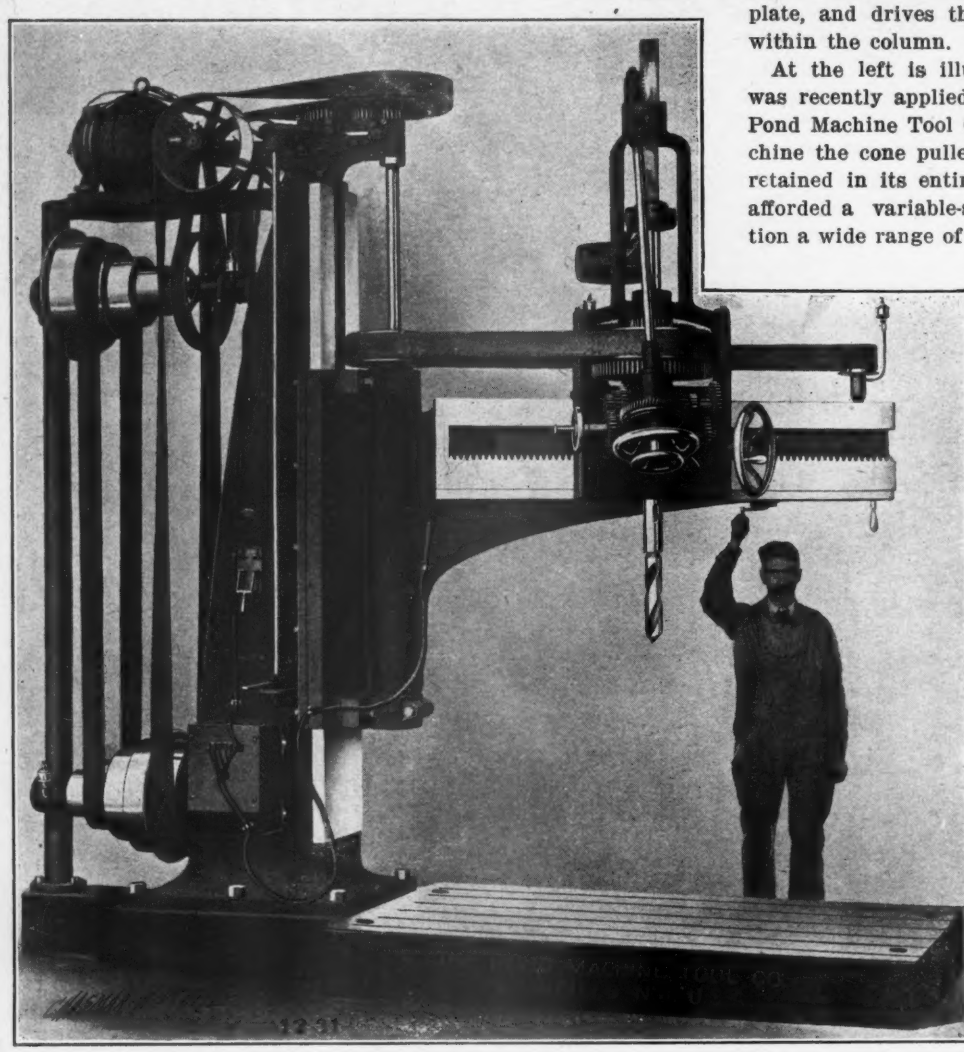
The larger engraving represents a 6-ft. full-universal Fosdick radial which has been adapted for a variable-speed motor drive. The result is an exceedingly neat drive, inasmuch as the use of all cone pulleys and belts is entirely obviated; it not only greatly simplifies the construction and operation of the drill, but also adds greatly to its general appearance. Cone pulleys and belts are rendered unnecessary by the use of the variable-speed motor, which is a 3-h.p. General Electric multipolar motor operating with field control.

In addition to the range of speeds provided in the motor two speed-changes are also obtained by means of two gear trains adjacent to the motor pinion. Either one is thrown into action by a friction clutch operated by the lever shown below on the column. The other interesting features of this universal drill are in no way interfered with, the most noticeable effect of the change being the absence of the cone pulleys and belts and the necessary accompanying supports, brackets, belt shifters, etc.



DIRECT-GEARED DRIVE UPON A 6-FT. FULL UNIVERSAL RADIAL DRILL.—FOSDICK MACHINE TOOL COMPANY.
GENERAL ELECTRIC VARIABLE-SPEED MOTOR BY FIELD CONTROL.

In the upper engraving is shown the method used by the Fosdick Company in applying a constant-speed drive. The machine shown is one of the 4-ft. plain Fosdick radials, which has been equipped with a 3-h.p. constant-speed, direct-current motor built by the Northern Electrical Manufacturing Company, Madison, Wis. This is a very convenient arrangement of adapting an individual drive to an existing tool without changing it greatly, as the motor may easily be mounted to drive the lower cone pulley through a conveniently arranged gear reduction. In this case the motor is mounted upon an extension of the base



COMBINATION CHAIN AND BELTED DRIVE UPON A 6-FT RADIAL DRILL.—POND MACHINE TOOL COMPANY.

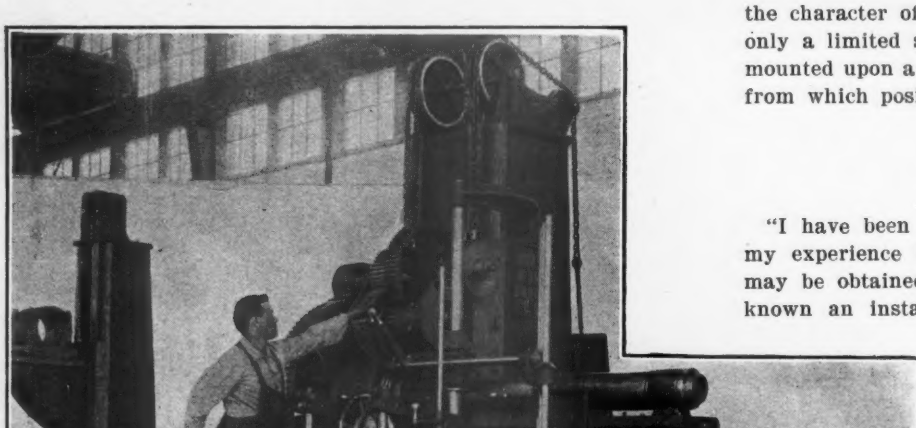
plate, and drives the lower cone shaft through bevel gears within the column.

At the left is illustrated a type of individual drive that was recently applied to a 6-ft. plain radial drill built by the Pond Machine Tool Company, Plainfield, N. J. Upon this machine the cone pulleys and standard belt drive to the arm is retained in its entirety; in addition to the speed-range thus afforded a variable-speed motor is used, from which combination a wide range of speeds are available.

The motor, which is a 3-h.p. Lundell motor at 1,000 revolutions per minute, is mounted upon a bracket above the upper cone pulley, from which it drives that cone shaft by a Renold silent chain. The balance of the drive does not differ from that on the standard radial. The speed variation is obtained by field control, the hand controller being located on the arm as shown above the man's head; a flexible cable effects the connections between the controller and resistance box located on the side of the column.

The engraving below illustrates an individual drive upon a large horizontal-spindle drilling, boring and milling machine, which indicates an excellent arrangement for applying electric driving to a large tool. This tool is the No. 5 boring machine, with 9 x 12-ft. platen, built by Beaman & Smith, Providence, R. I., one of which was thus equipped for the new shops of the United States Navy Yard at Brooklyn, N. Y. The motor is a 10-h.p. constant-speed direct-current motor, supplied by the General Electric Company.

Only a limited number of different speeds are available from belt cone and gear changes in this drive, but on account of the large size of the tool and the character of the work to be handled, it is probable that only a limited speed range would be needed. The motor is mounted upon a bracket located in place of the driving pulley, from which position it drives direct through gearing.



GEARED DRIVE UPON A LARGE HORIZONTAL DRILLING AND BORING MACHINE. —BEAMAN & SMITH.

UNDISCOVORED MERIT.

"I have been some time in this world, and the result of my experience is that there is one way by which success may be obtained with ability. In all my life I have never known an instance of undiscovered merit. There are too many seekers to allow ability to remain hid. If you possess ability and were placed in a diving bell and lowered to the bottom of the sea, expeditions would be fitted out to discover you and bring you back.

"No matter what calling you embrace, if you have ability you will be in demand. If a lawyer, think how many persons there are in trouble who would be seeking your advice. If a physician, how many there are who are ill who would want your services. If an architect, how many who desire better houses built. I have heard it said that a young man needs a pull to get a start. Pay no attention to that. If you have ability you will win."—The Hon. W. Bourke Cockran, in an address to the graduates of Manhattan College.

THE WELLMAN-STREET STEEL CAR.

The accompanying illustration shows the general appearance of a new design of steel hopper car recently built by the Wellman-Seaver-Morgan Engineering Company, of Cleveland, Ohio, under patents issued to S. T. Wellman and Clement F. Street. This car is a radical and interesting departure from the designs in common use. The object was to reduce the number of points at which corrosion will be likely to take place, to produce a car which shall be self-clearing and also one which can be repaired at a low cost.

The center sills consist of two 15-in. channels with flanges turned toward the center. A gusset plate is riveted to the outside of each channel and extends from one center plate to the other. An angle iron is riveted to the lower edge of this gusset plate, forming a girder 27 ins. deep at the center, and extending from truck to truck. This girder is designed to have ample strength for carrying the entire load of 100,000 lbs.

It will be noted from the illustration that the side plates are curved, and that the customary form of side sill is entirely eliminated. The result of this curved form of plate is a car which will readily clear. A careful measurement shows that the lineal feet of joint exposed to load is 45 per cent. less than in the customary form of car. The manufacturers claim that as corrosion begins at these points, the life of this car will be very much longer than that of any other in use. The elimination of the customary form of side sill makes a material reduction in what the manufacturers of this car claim to be unnecessary dead weight, and this weight has been put in the plates of the car where it is believed to be more effective. These plates are 5-16 in. thick instead of ¼ inch, as in customary practice. One of the important advantages claimed is the large area of door openings. This is 56 sq. ft., while in most steel cars it is only from 20 to 25 sq. ft. This very large door opening, together with the curved form of plate employed, contribute to the clearing of the load.

The ends of the center sills of this car are tied together by a heavy steel casting, and this casting serves also for the central portion of the end sills. The ends of the end sills are formed of short pieces of 8-in. channels, securely riveted to the steel castings referred to and extending to the sides of the car. The push pole socket is riveted to these channels and also to a short 8-in. channel, which extends from the corner of the car to a heavy steel casting riveted to the side of the car close to the door opening. This construction is further stiffened by two angles extending from the corner of the car back to the body bolster near its junction with the center sills. As most of the damage to steel cars is caused by corner blows, this gives a construction which can be easily repaired. The idea is that under a corner blow the only parts receiving damage will be the channels and angles referred to. As these are commercial shapes they can be readily renewed, or if not too badly damaged they may be straightened and replaced.

This car was placed on exhibition at the recent convention of the Master Car Builders' Association, and created a great deal of interest among the railroad officers. The criticisms indicated a general feeling that this car presents valuable features and that its success is assured. The sample car has gone into exceedingly severe service, where its merits will be effectually tested. Further information may be had from Mr. Clement F. Street, manager of the railway department of the Wellman-Seaver-Morgan Engineering Company, Cleveland, Ohio.

THE WELLMAN-STREET STEEL CAR.

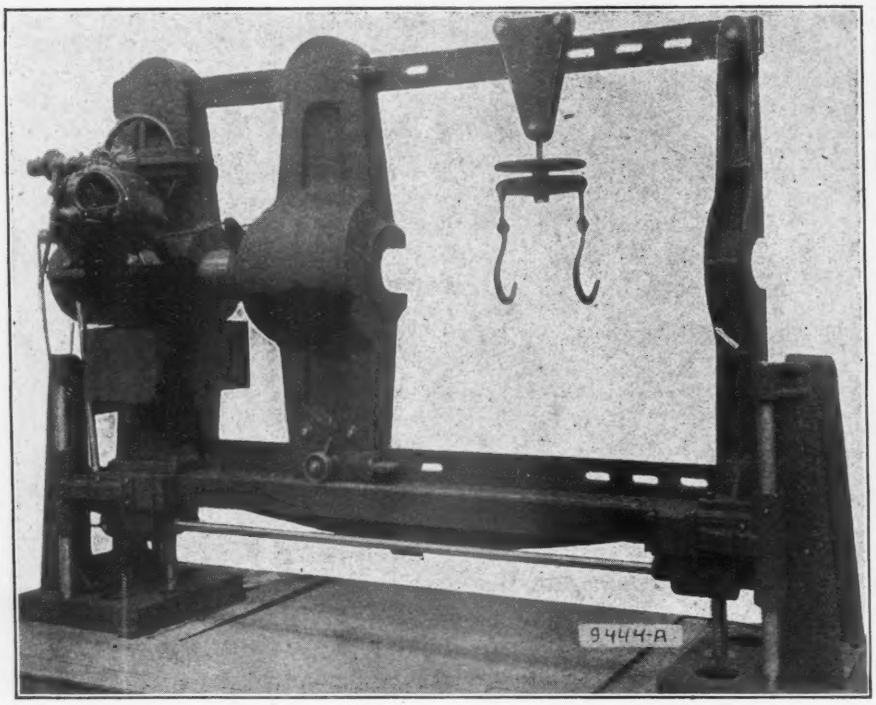
WELLMAN-SEAVER-MORGAN ENGINEERING COMPANY.

Motor Speed Control.—We are in receipt of a valuable treatise upon the subject of speed control for electric motors, which has been reprinted from a paper entitled, "Methods of Speed Control," read by Mr. Wm. Cooper, before the American Institute of Electrical Engineers. It is an important paper, inasmuch as Mr. Cooper has in a singularly well-directed manner so chosen his remarks as to make clear many points which are the least understood, or those concerning which the experts upon motor driving differ in opinion; his remarks will be appreciated at present in view of the prevailing difference of opinion as to the relative advantages of direct and alternating current for electric driving equipments for shops. Mr. Cooper is an acknowledged authority upon this subject and is well known for his former connection during the past eight years with the Bullock Electric and Manufacturing Company, Cincinnati, Ohio. During his time there he devoted particular attention to a thorough study of the multiple voltage system of motor speed control, as well as also a very careful study of all other methods of speed variation for electric motors. All interested in this important subject cannot fail to be interested in the attitude that Mr. Cooper takes in regard to it, and we recommend his works to their attention. His present address, as consulting mechanical and electrical engineer, is 732 Union Trust Building, Cincinnati, Ohio.

NEW DESIGN OF HYDROSTATIC WHEEL PRESS.

MOTOR DRIVEN, WITH SPECIAL ELEVATING MECHANISM TO OBVIATE THE USE OF CRANES.

The engraving presented herewith illustrates a novel design of wheel press, recently built for the Renovo shops of the Pennsylvania Railroad, by the Niles Tool Works Company, Hamilton, Ohio, which merits attention for its elevating mechanism, whereby the entire machine may be raised or lowered to permit the various sizes of driving wheels to be rolled in without lifting. This design originated with Mr. H. D. Gordon, formerly master mechanic of the Juniata shops of the Pennsylvania Railroad, the special purpose of the design being to avoid the necessity of using cranes to place the wheels and axles in position.



NEW 400-TON WHEEL PRESS, WITH SPECIAL ELEVATING MECHANISM.

NILES TOOL WORKS COMPANY.

The machine is driven by a General Electric constant-speed, multipolar motor which is mounted upon a neat bracket at the rear of the hydraulic cylinder. The motor drives the pumps through a gear reduction, and also there is a bevel gear drive and clutch arrangement by which it may operate the elevating mechanism. The elevating mechanism consists of an elevating screw at each end, both of which are operated together by a worm on the long interconnecting shaft below the bed. The machine is guided in elevating by two stands bolted to the foundations, carrying heavy guide-rods. No gears for operating the elevating screws are running unless the machine is being elevated, a single lever being used to throw the elevating mechanism in or out of action.

The pump is double-acting, has two sizes of plungers and three speeds of delivery, and one or all of which are under instant control by trip-valves. The pressure-gauge is graduated for tons of pressure and for pounds per square inch on the ram. The sliding-head is supported by rollers running on planed ways on the base, and is held in position by large steel keys.

The maximum distance between tie-bars is 96 ins., while that between the end of the ram and sliding-head is 8 ft. 8 ins. The opening in the head for axles is 12 ins. The movable portion of the machine is mounted on a base-plate, to which, however, no strains are transmitted except those due to carrying the weight of the parts. All of the thrust is taken by the tie-bars.

THE DAKE PNEUMATIC AIR MOTOR AND CHAIN HOIST.

The accompanying engravings illustrate the design of this simple and very effective pneumatic air motor for general railway shop uses. The pneumatic chain hoist, which is shown in Fig. 1, consists of a Dake reversing air motor directly connected to an ordinary chain block of a standard make. Two pendant hand chains control the motor valve, to which is also attached a lever to operate the valve stem on the oil cup, giving automatic lubrication to the motor only when the hoist is being used. The worm and worm-wheel are of steel and phosphor bronze, and are enclosed in an oil tight case. All parts of the hoist are of sufficient strength to sustain a load of twice their rated capacity. The air motor used with this hoist is of the double reciprocating square-piston type of engine, and is favorably known as a desirable motor for direct

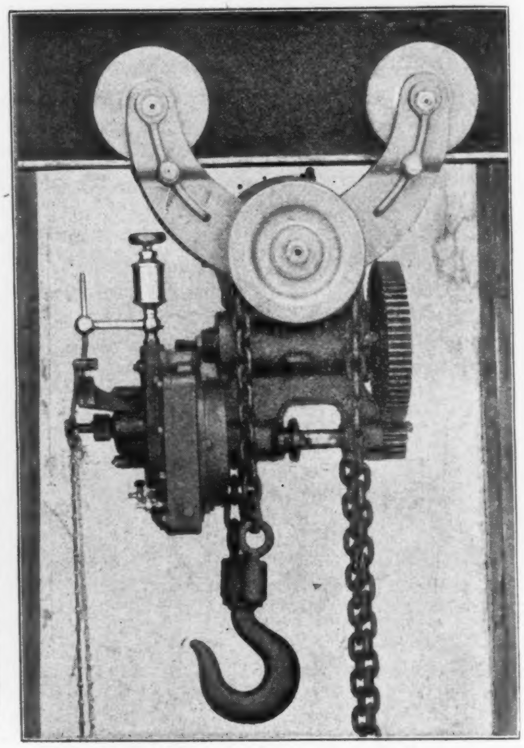


FIG. 1.—THE DAKE PNEUMATIC CHAIN HOIST.

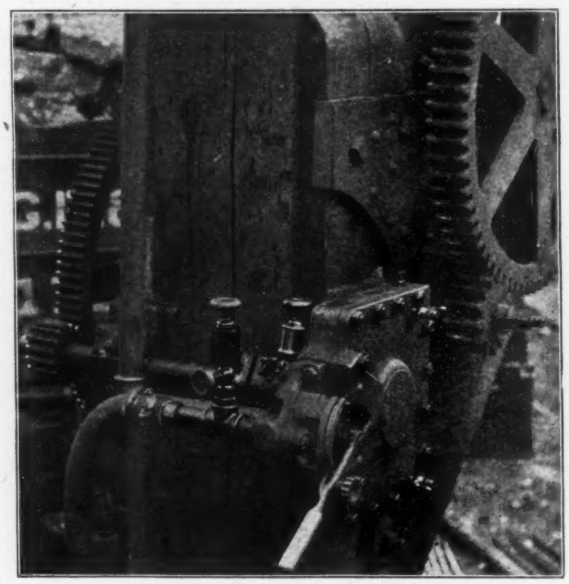


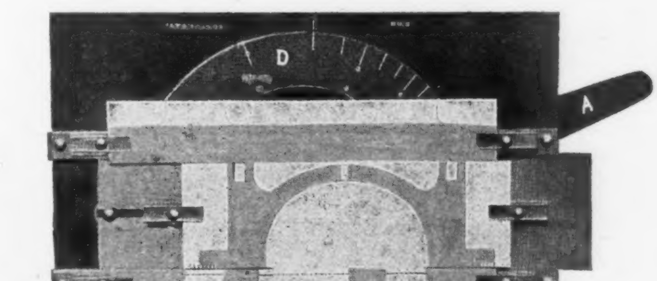
FIG. 2.—VIEW SHOWING APPLICATION OF THE DAKE AIR MOTOR TO A HAND CRANE.

connection work where it is desirable to use a small, compact and high-speed motor.

One of the many useful applications of the Dake air motor is shown in Fig. 2, which illustrates a hand crane that has been changed to a power crane by its application. The convenient form of this motor makes it a very desirable power for unloading derricks in freight repair yards, for railroad turntables, centrifugal pumps, fans, blowers and all classes of hoists. The Holland Company, 77 Jackson Boulevard, Chicago, are the manufacturers of this interesting device, and from them any desired information or drawings showing special arrangements of the hoist or any particular uses of the air motor can be had.

COMPACT VALVE MODEL.

A very ingenious and convenient model for the study of locomotive valve motion, developed by Mr. F. H. Colvin, is illustrated by this engraving. It is arranged for D valves of 5, 6 and 7-in. travels, for piston valves with both inside and outside admission, for the Vauclain piston valve and the new Wilson balanced slide valve. It is made of steel and is packed in a box 14 x 18 ins. When in use the box forms a base. The valve movement is ingenious and so arranged that one person can make adjustments, move the valve and study the movement, without the slightest difficulty. No wrenches are required, thumb screws being provided to put it together. The valves and seats are represented upon printed cards, which are secured in position by buttons, as shown in the engraving. Motion is obtained for the travel of the valve by a novel arrangement of slotted plate at the rear; this is turned by handle, A. The graduated disc, D, shows always at a glance the position of



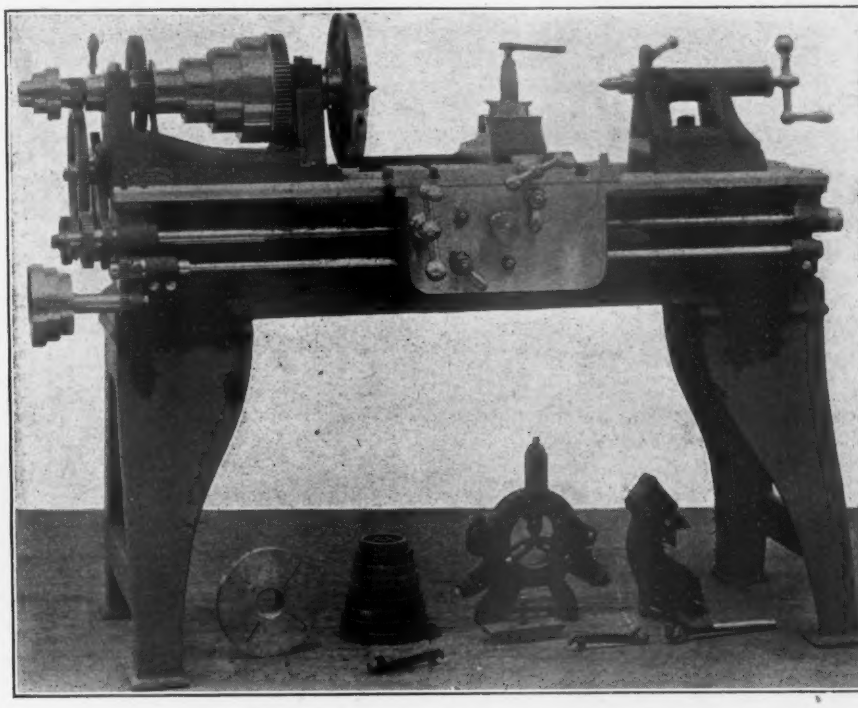
A NEW DESIGN OF VALVE MODEL.

the valve, all the movements being always in plain view. These convenient models are manufactured by the Derry-Collard Company, 256 Broadway, New York, from whom further information may be obtained. This model will be valuable in the drafting room, lodge room and air-brake instruction car. The valves are shown full size and the model represents a 24-in. cylinder locomotive.

AN IMPROVED 15-INCH LATHE.

SEBASTIAN LATHE COMPANY.

The engraving presented herewith is a view of the new model of the 15-in. swing engine lathe of the Sebastian Lathe



THE IMPROVED 15-IN. ENGINE LATHE.—SEBASTIAN LATHE COMPANY.

Company, Cincinnati, Ohio. We desire to call the attention of of our readers to several important features in which the Sebastian lathe has of late been improved, bringing it entirely up to date and rendering it a rapid producer.

As may be noticed, all the parts appear heavy and substantial for a lathe of this size. The makers state that the live spindle is made of a high grade of special steel, the bearings are of the best phosphor bronze, and provision is made for constant lubrication. The carriage is of an improved design, has long bearing on the ways, and is provided with ample lubricating devices. It is gibbed to the bed both front and back. The lathe is arranged to cut either right or left hand threads, or feed either right or left. It has both screw and rod feeds, as well as power cross feed, and is provided with the usual number of extras, including steady rest, follower rest, large and small face plates, gears to cut from 5 to 36 threads, and a friction counter shaft.

SPECIFICATIONS.

Swings over bed	15 ins.
Swings over carriage	$8\frac{1}{2}$ ins.
Length of bed	6 ft.
Takes between centers	40 ins.
Front bearing	2 3-16 ins. diameter x $3\frac{1}{2}$ ins. long
Hole through spindle	1 5-16 ins.
Weight	1,200 lbs.

THE CHICAGO-PACIFIC COAST RECORD BROKEN.

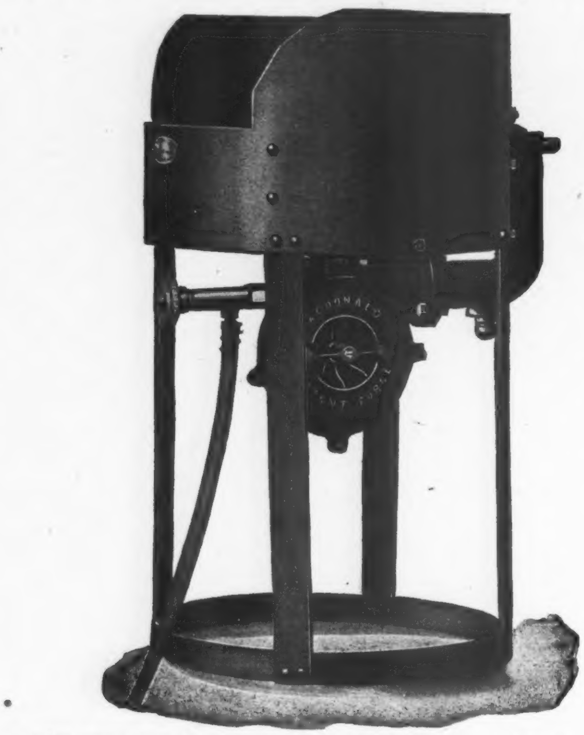
The special train which carried Mr. Henry P. Lowe from Chicago to Los Angeles, Cal., left Chicago at 10.17 A. M., August 8, 23 minutes after Mr. Lowe's arrival from New York on the "Twentieth Century Limited." The train, consisting of the dining car "Rocket," a baggage car and locomotive, was given right of way to Los Angeles, and stopped only for fuel and water. The run of 2,267 miles was made in 52 hours, 49 minutes, an average of 42.8 miles per hour. The total distance from New York to Los Angeles, 3,246 miles, was made in 73 hours, 21 minutes, thus establishing a new record.

Tensile tests of paper made on the government testing machine at the Watertown arsenal showed that strong blue print paper has a tensile strength of 9,700 lbs. per sq. in. and 65-lb. 23 x 28 ins., linen paper has over 9,000 lbs. per sq. in.

A NOVEL AIR OPERATED FORGE.

The Chicago Pneumatic Tool Company, Fisher Building, Chicago, have just placed upon the market a new design of portable blacksmith forge which is intended to operate by compressed air. It differs from the other forges built by this company in that it is to use with coal or coke, instead of fuel oil; fuel oil forges are also a specialty of the Chicago Pneumatic Tool Company.

The compressed air supply for the air forge enters through a hose and a ¼-in. standard pipe connection; it passes through a 1-16 needle valve jet, forcing the fan to revolve rapidly, and as the fan is open to the outer air, a blast of free air is continually blown through the tuyere. This method of using air to operate the fan, in addition to giving excellent results, effects a considerable saving in the amount of air consumption.



THE NEW CHICAGO AIR FORGE, OPERATED BY COMPRESSED AIR.

This forge uses either coal or coke, coke giving possibly the best results. It operates with an air pressure of from 60 to 100 lbs., and consumes approximately from 5 to 7 cu. ft. of free air per minute. The fan revolves at approximately 4,000 r.p.m. at 80 lbs. pressure. It is 3 ft. high over all and the pan, or firebox, is 20 ins. in diameter x 10 ins. deep. The forge weighs 114 lbs. complete.

THE NEW WAUGH SPRING DRAFT GEAR.

The new Waugh spring draft rigging which was on exhibition at the recent M. C. B. convention is illustrated in the accompanying engravings in general construction and in action in service. The construction considered in detail consists of two pocket castings of steel, recessed 1 in. in the timbers and having flanged projections extending along the inner face of the draft sill and bolted through the timber to prevent the timbers from splitting. Two lugs are cast on the inner face of the pocket casting on which slide the abutment blocks, D, which are provided with oblong slots to fit over the lugs to allow the abutment blocks, D, to change position, as the followers travel in either direction.

The caps, E, are mounted upon the lugs to hold the abutment blocks in position and also to center the coil spring. The coil spring is a standard 8-in. x 6¼-in. double-coil spring. The plates composing the followers are all of spring steel, ¼-in. thick, 6 ins. wide and 12 ins. long. Groups B and B¹ are the main followers and are each composed of 8 plates of the above dimensions; groups A and A¹ are auxiliary followers and, as shown, are each composed of 6 straight plates of the same dimensions.

The thimbles, F and F, are inserted in either end of the coil spring, the inner ends of which come in contact ⅛-in. before the coil-spring is closed, thus preventing the coil-spring from being driven solid. Separating each auxiliary group of followers from the main group is a separating block, C, which is made up of two parts, one part provided with lugs, and the other with corresponding holes, and between the parts is a steel plate 1-16 in. thick, of the same length and width as the follower plates, simply to hold block C in the center. The surface of block C in contact with the auxiliary group is an oval of ⅝-in. curvature, these being the curvatures taken by the auxiliary and main groups of plates when the coupler has traveled 2⅛ ins. in either direction.

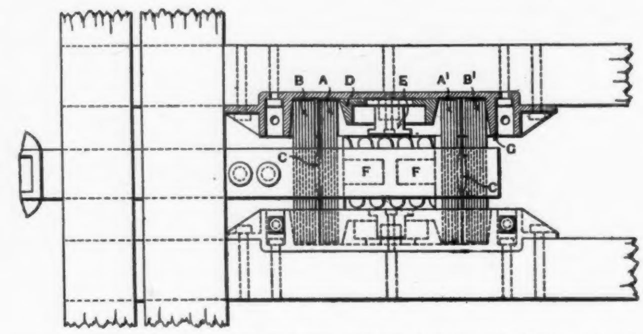


FIG. 1.—DETAILS OF THE WAUGH DRAFT GEAR, SHOWING ALL PARTS AT REST.

In Fig. 1, in which all parts are shown at rest, the ends of the abutment blocks, D, are not in contact with the auxiliary groups, A and A¹, and the opening admits of the coil spring being compressed ⅜-in. before pressure is exerted on the auxiliary groups through the abutment blocks, D.

In service the gear has three distinct grades of cushion: The *first* is, when the coil spring has been compressed ⅜-in., the backward movement of auxiliary group A will slide the abutment blocks, D, until they come in contact with the auxiliary group A¹, and in this travel about 7,000 lbs. of the capacity of the coil spring has been utilized. In the *second* action, the coil spring has been compressed 1¼ in. more, and each auxiliary group has been curved ⅝-in., but in opposite directions, by the abutment block D, and 83,000 lbs. of the blow has been absorbed on a total travel of 1⅝ in. It may be seen that the bearing shoulders of the pocket for the main followers are not at right angles to the wall of the pocket, but diverge at an angle which will allow the followers, B¹, to be curved ⅜-in. out of a straight line before taking the angle of the shoulder. In the *third* action, which is shown in Fig. 2, the thimbles in the springs are in contact and the pressure is directed along a center line through the thimbles F, and separating blocks C, to the center of the rear followers, B¹, the latter, when curved to the angle of the shoulders, making a total travel of 2 ins., having absorbed a blow of 183,000 lbs., as shown by a compression test.

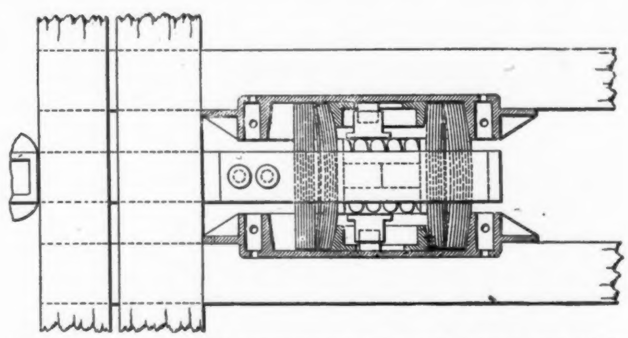


FIG. 2.—DIAGRAM SHOWING DISPOSITION OF PARTS WHEN THE COUPLER HAS REACHED ITS LIMIT OF TRAVEL.

When the coil spring has been compressed until the abut-

ment blocks are brought in contact with each auxiliary group, A and A[1], from that point to the limit of travel of the coupler, the force of the blow is resisted by front and back followers alike and in opposite directions through the abutment block, D; and so long as the coupler travels there is a resiliency in the spring plates and the draft gears or timbers do not receive a solid shock. With 2⅛ ins. travel of the coupler, only one-third to two-thirds of the elastic limit of the plates has been used. The adhesion of the smooth surfaces of the steel plates in each group by pressure through the abutment block to curve them, assisted by the check offered by the abutment block

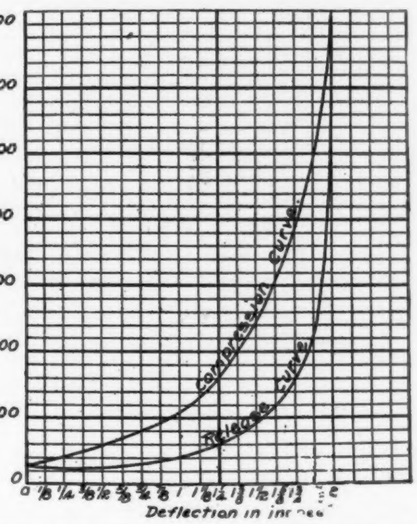


FIG. 3.—RESISTANCE CURVES OF THE WAUGH DRAFT GEAR.

to their return to a straight position until the coil spring is released, prevents the recoil; what has been shown of the action in buffing shocks is true under tensile strains. Tests made with different combinations of the plates show resistances of from 93,000 lbs. to 125,000 lbs.; 166,000 lbs. to 183,600 lbs., and 218,000 lbs. in 2 ins. of travel.

This device has been used by several railroad and car companies on high capacity cars, giving perfect satisfaction, and the 125,000 lbs. capacity has been adopted by some railroads on their passenger equipment. The gear, which was patented by Mr. J. M. Waugh, is manufactured and sold by the Waugh Draft Gear Co., Monadnock Block, Chicago.

BOOKS AND PAMPHLETS.

Equipment of a Railway Shop. A Description of the New Locomotive and Car Shops of the Lake Shore & Michigan Southern Railway at Collinwood, Ohio. (Abstract from the AMERICAN ENGINEER AND RAILWAY JOURNAL, October, 1902, to June, 1903.) Bulletin No. 35, 34 pages in pamphlet form, fully illustrated. Issued by the Crocker-Wheeler Co., Ampere, N. J.

The above is the title of an interesting pamphlet which was recently issued by the Crocker-Wheeler Co. in an attempt to set forth the important features of the large motor-driving equipment which they installed at the Collinwood shops. A complete and comprehensive description of the electric generating plant, the distribution system and the motor equipment for the drives is presented in a manner that cannot fail to be of interest to all who are concerned with the railroad repair shop problem. It undoubtedly constitutes the most complete exposition of the Crocker-Wheeler system of multiple-voltage motor speed control that has been published. In this installation the Crocker-Wheeler form I motor predominates, and numerous illustrations are presented showing various applications of them to the different machine tools. Also the merits of the mixed distribution system, comprising four wires for the variable-speed motors and two wires for the constant-speed motors and lighting, are set forth very clearly. This pamphlet is typographically a work of art; particular attention should be called to the design for the cover, which is symbolic of the advantages of the electrical method of driving shop machinery. It should be in the hands of everyone interested in motor-driving.

Manual for Engineers. Published by the University of Tennessee, Knoxville, Tenn. Third edition. Price 50 cents.

This is a little vest-pocket book of 224 pages, containing tables and data convenient for use of engineers and draughtsmen. Wherever space is available the pages are footed with terse paragraphs directing attention to the advantages of technical education. Its object is to bring to the attention of the men of affairs of the South the value of technical training. The fact that this is the third edition speaks for the reception given by the public. It is a very convenient little book. The compiler is Prof. Charles E. Ferris, of the University of Tennessee.

Experiments on the Flexure of Beams, Resulting in the Discovery of New Laws of Failure by Buckling. By Albert E. Guy. 1903. 122 pages. D. Van Nostrand Co., 23 Murray street, New York. Price $1.25.

This volume is a reprint of a series of articles which were recently published in the *American Machinist*. The first portion of the book is devoted to a discussion of the beam formulæ in common use, and the demonstration of their insufficiency to provide for the buckling tendency of the compression portion of the beam. The remainder of the work is given up to the description and discussion of the tests made by the author with the object in view of devising a formula applicable to slender beams. Certain laws are deduced and their similarity to the Euler column formula is shown. Altogether the book forms an interesting and valuable addition to engineering literature, and should lead to further investigation in this hitherto unstudied field.

The American Steel Worker. By E. R. Markham. 343 pages, 8vo. Fully illustrated. 1903. Published by the Derry-Collard Company, 256 Broadway, New York. Price $2.50.

This is a work of the utmost importance to all mechanics and shop men. The author, with his experience of twenty-seven years with the firm of J. H. Williams & Co., Brooklyn, N. Y., well known for their specialty of drop forgings, needs no introduction to those familiar with the technical press. He is an acknowledged authority upon all subjects relating to the selection, annealing, working, hardening and tempering of the various kinds and grades of steel, and these subjects have been treated exhaustively by him in this new volume. The wording is unusually clear and concise, and is in plain language, without any attempt at embellishment. Actual cases are cited, and the methods of treatment, as well as the results, are given in clear language. The illustrations are numerous and better than usually found. The index is very complete and affords a ready means for locating any information it contains. While nothing elaborate has been attempted, the binding, cover and general make-up are better than usually found in technical books, and will, we believe, be appreciated by readers. We beg to call attention to the fact that the Derry-Collard Company will send a copy of this book anywhere in North America "on approval," according to their method, to be paid for or returned as desired. We are also pleased to note that purchasers of this volume are entitled to write and inquire of the author, Mr. E. R. Markham, care of the Derry-Collard Company, regarding any case of heat treatment of steel they may have which is not covered in the book; this will prove an important feature to the practical reader of this work, by whom it will be appreciated.

Modern Locomotive Practice. A Treatise on the Design, Construction and Working of Steam Locomotives. By C. E. Wolff. Illustrated with 150 engravings and 8 folded plates. Published by D. Van Nostrand Company, 23 Murray street, New York. 1903. Price, $5.00.

This is an English book, by an English author, and naturally is written from the standpoint of English practice. The first subject is train resistance; the next, type of express locomotives, followed by a discussion of the locomotive as a carriage, tracking and track construction. The other subjects are boilers, cylinders and valves, link motions, valve gears, connecting rods, crossheads and slides, crank axles, balancing wheels, brakes, modern locomotives and compounds.

Its greatest direct value is to English readers, but others will find many valuable discussions. In the absence of a thoroughly good and "up-to-date" treatise on the locomotive, any work on the subject is welcomed, but to attempt to properly justify this title in 265 pages is to fall short of what is so greatly needed. The book under review seems to deal with details rather than general principles and it treats only a few of the important details. The author should be encouraged to enlarge his work to four or five times its present size and apply Mr. Forney's ideal to present conditions.

The author approaches his subject from the standpoint of a student of mathematics, and while such treatment looks well in print, what is wanted is a presentation of English practice which will reveal the methods of the designers in attacking the problem of bringing out a new locomotive to meet certain definite conditions of train, grade and schedule. English locomotives are beautiful mechanically and they do remarkable work. American readers would like to know why this is accomplished with such relatively light engines. These comments are not offered in a spirit of fault-

finding, but in order to indicate the reviewer's idea of the opportunity which lies before him who knows how and has the information necessary to write a book on locomotive practice. It is not a matter of constructive detail alone, but capacity for steam making and steam using, that we all want to study. The book gives a valuable record of English practice but is not sufficiently complete.

Massachusetts Railroad Commissioners' Report, 1903. This volume of 700 pages contains the annual report of this commission, including observations upon the extension of electric railways, accidents, rolling stock, etc., and the usual voluminous statistics of the roads of that State, including the street railways.

Grinding and Polishing Machinery.—The Webster and Perkes Tool Company, Springfield, Ohio, have issued a pamphlet descriptive of their self-oiling bench and pedestal grinders, which will be of interest to railroad shop men. For modern self-oiling and dust-proof construction these machines are highly recommended, and merit attention from prospective purchasers.

Otis Elevators.—We are in receipt of a catalogue from the Chicago office of the Otis Elevator Company, describing the extensive line of passenger and freight elevators, both electric and hydraulic, that are built by them. The success which the Otis Company is meeting in the line of electric elevators is indicated by the fact that over 10,000 of their elevators of this type are in successful use. The catalogue also illustrates sidewalk hoists, plunger elevators, escalators, etc.

The Rand Drill Company are calling attention to the magnitude of their exhibit at the recent Master Mechanics' and Master Car Builders' conventions at Saratoga, by sending out a large illustrated card which presents a comprehensive view of their booth. Working models of their Imperial steam-driven compressor, their Imperial motor-driven compressor, their Imperial gas-engine compressor and their Imperial air hammers, piston air drills, and wood-boring machines, were shown in operation in the same, from which an idea could be drawn of the extensive character of their business.

Multiple Drills.—This is the title of a large 9 x 12 catalogue that has recently been issued by the Niles, Bement, Pond Company, of New York, relative to their various lines of multiple drilling machinery, with adjustable spindles. The magnitude of the production of this class of machine tools by this company cannot be appreciated without seeing the catalogue. The machines illustrated therein are of two general types—multiple drills, in which the spindles are adjustable to any position in a given line, and adjustable multi-spindle drills, in which the spindles may be arranged in a group of any shape or size within the capacity of the machine. These include not only their standard heavy multiple drills of Niles and Bement designs, adapted to railroad and general work, but also several machines of Pratt & Whitney Company's design, specially built for the drilling of duplicate parts in the manufacture of automobiles, typewriters, and other light work.

EQUIPMENT AND MANUFACTURING NOTES.

Mr. W. O. Duntley, vice-president and general manager of the Chicago Pneumatic Tool Company, left Chicago recently for a several weeks' trip to the Pacific Coast in the interest of his company. He states that business in the pneumatic tool line is in a flourishing condition, and that in spite of the usual depression incident to this season the various plants of his company are yet working increased forces in order to take care of the business already on hand. We are also informed that their representative on the Coast, Mr. Henry Engels, located at 91 Fremont street, San Francisco, has lately secured a number of large orders for pneumatic equipment for a number of Western concerns, including a number of the Franklin air-compressors manufactured by the Chicago Pneumatic Tool Company.

The Falls Hollow Staybolt Company have opened an office in the Vanderbilt building, 132 Nassau street, New York, for the sale of their well-known hollow and solid staybolt iron. The office is in charge of Mr. Fred F. Bennett, who also represents C. B. Hutchins & Sons, Detroit, Michigan, manufacturers of freight car roofs and roofing materials. Mr. Bennett is well known to the railroad supply trade through his connection with the railroad press, the American Steel Casting Company and the Chicago Pneumatic Tool Company.

Portable quarters for workmen are one of the specialties that are handled by the Walter A. Zelnicker Supply Company, St. Louis, Mo. Quarters that can be easily and quickly moved as work progresses, and taken from one field of operation to another, will be of interest to contractors. The improved sanitary condition resulting from such an arrangement is also a decided advantage. The Zelnicker Company, who have these cars for sale, state that they can be furnished at prices as reasonable as that for which the ordinary huts can be built.

We are informed that the G. Drouve Co., of Bridgeport, Conn., are receiving many contracts for the installation of their improved Lovell window and shutter operating apparatus. Among their recent installations may be mentioned the Union Steam Pump Company, Battle Creek, Mich.; Ansonia Brass and Copper Company, Ansonia, Conn.; Cumberland Electric Light and Power Company's power-house, Nashville, Tenn.; the Union Typewriter Company's building, Syracuse, N. Y.; and the Monessan (Pa.) plant of the Pittsburg Steel Company.

The United States Graphite Company, Saginaw, Mich., sole miners of Mexican graphite, believe their No. 204 lubricating graphite to be the handiest as well as the most efficient supply of its kind for use in the engine-cab or roundhouse. They recommend it for use dry or in connection with oils and greases. Firemen will be interested to know that this product is also urged by the producers as the ideal pigment for the preparation of a locomotive front-end dressing—it is easily prepared, gives a fine, glossy finish, and it is claimed that it possesses unusual virtue for withstanding the trying conditions to which the front end is always subjected. This company offers to send free on request a quarter-pound can sample of dry lubricating graphite to any railroad man interested in its use.

Pneumatic Tool Patents.—An opinion was rendered Monday, June 29, by Judge Lacombe, of the Circuit Court of the United States for the Southern District of New York, in the suit of the Chicago Pneumatic Tool Company against the Philadelphia Pneumatic Tool Company on the Moffett Drill Patent, No. 369,120, of August 30, 1887, denying the motion of the defendant to dissolve the injunction which was granted against them some time ago, restraining them from manufacturing, selling or using portable pneumatic drills in infringement of rights under the above-mentioned patent. This decision is the result of continued efforts on the part of the Philadelphia company to escape this injunction and is most full and complete substantiation of the claims of the Chicago Pneumatic Tool Company.

The Westinghouse Traction Brake Company report a large number of sales of street-car air-brake equipments. Among the more recent may be mentioned the following, all of which equipments are provided with motor-driven compressors:

Seven equipments to the Wooster & Southbridge Street Railway Company.

Eight equipments to the Concord & Manchester Street Railway Company.

Twelve equipments to the Concord Street Railway Company.

One equipment to the Holland Palace Car Company for use on their new electric railway sleeping car.

The following is a list of some of the roads that have recently been equipped with their new magnetic brake and car-heating system.

Pennsylvania & Mahoning Valley Railway Company, New Castle, Pa.—Equipments for sixteen cars.

Morgantown Electric & Traction Company.—Equipments for twelve cars.

Washington & Canonsburg Railway Company, Washington, Pa.—Equipments for fifteen cars.

Altoona & Logan Valley Electric Railway Company.—Equipments for eight cars.

We understand that the Manhattan Elevated Railway Company, New York City, has drawn up plans to install moving stairways at its Thirty-third street and Forty-second street stations for both the uptown and the downtown platforms. It is believed that the company has been influenced by the fact that the receipts of the uptown station at Sixth avenue and Twenty-third street have increased at a greater ratio than at any other station of the system since the moving stairway was installed there, about two years ago. The contract between the city of New York and the Subway Construction Company provides that where station platforms are more than 30 ft. below the level of the street, mechanical conveyances must be provided; the Subway Company has accordingly arranged to install moving stairways at several of its stations.